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AGRICULTURE AND SCIENTIFIC RESEARCH.

The old country has at last awakened to some purpose to the desirability of encouraging scientific research in connection with agriculture, realising, as Canada, Germany, the United States, and other countries have realised, that without progress in the pure sciences that underlie agriculture, progress in agriculture itself must be slow and halting. To leave agriculture to depend upon the general progress of the underlying sciences is by no means the best way; to provide those sciences with funds and demand special progress in directions that bear upon agriculture is better. And this is what is being done, as will be seen by a perusal of the extract from the *Times* given below.

What the general public, however, requires to learn is that scientific research is *slow*, and that results must not be expected in a few weeks or months. This has been the great fault in the work of a good many Departments of Agriculture, results being hurriedly produced, only to find that they require complete revision or modification in a few years. The experiments carried on at Peradeniya with the manuring of Cacao, the results of which will be published almost at once if they are not actually out when this appears, afford a very good case in point. Had we published them some years ago, many meanings might have been put into them which fuller experience shows them incompetent to bear. In this connection we may with advantage quote the presidential address to the agricultural section of the British Association, given a short time ago by Mr. W. Bateson.

Agricultural Section.

In his address to the agricultural sub-section, Mr. W. Bateson, before dealing with the physiological, pathological and genetic aspects, emphasised the wide scope of the applied science of agriculture. He did this in view of the present very remarkable outburst of activity in the promotion of science in its application to agriculture, particularly with the provision on a considerable scale in England for the first time of a national subsidy in the form of the Development Grant. He pointed out the danger of requiring the issue, as was done under a similar scheme in the United States, of periodical bulletins or reports of progress. If it were true that the public really demanded continual scraps of results, and could not trust the investigators to pursue research in a reasonable way, then the public should be plainly given to understand that the time for

inaugurating researches in the public's name had not arrived. It could not be too widely known that in all sciences, whether pure or applied, research was nearly always a very slow process, uncertain in production, and full of disappointments. The research of the present day could aspire no higher than to lay the foundation on which the following generations would build. Both those who were engaged in agricultural research, and those who were charged with the supervision and control of those researches must be prepared to exercise a large measure of patience. The applicable science must be created before it could be applied. It was with the discovery and development of such science that agricultural research would for long enough best occupy its energies. The man who devoted his life to applied science should be made to feel that he was in the main stream of scientific progress. To tell him that he must not pursue that inquiry further because he could not foresee a direct and immediate application of the knowledge he would acquire was a course detrimental to the real interests of the applied science. There were specific instances where, in other countries, thoroughly competent and zealous investigators had, by the shortsightedness of superior officials, been thus debarred from following to their conclusion researches of great value and novelty.

In this country, where the Development Commission would presumably for many years be the main instigator and controller of agricultural research, the constitution of the advisory board, on which science was largely represented, formed a guarantee that broader counsels would prevail, and it was to be hoped that not merely this inception of the work, but its future administration also would be guided in the same spirit. So long as a train of inquiry continued to extend, and new knowledge was coming in the enterprise would not be in vain, and it would be usually worth while to pursue it.

£50,000 A YEAR FOR RESEARCH.

The Board of Agriculture and Fisheries have been in communication with the Development Commissioners with a view to the formulation of a scheme for the promotion of agricultural research and local investigations in England and Wales, and the Treasury, on the recommendation of the Commissioners, have now sanctioned the allocation of funds to be distributed by the Board in accordance with the general principles set out below. The total *maximum* sum which will be expended when the scheme is in full operation will be about £50,000 per annum.

The scheme provides for:—

1. A system of agricultural research which will secure for each group of the problems affecting rural industry a share of attention roughly proportional to its economic importance.

2. The concentration of the scientific work on each group at one institution or at institutions working in combination.

3. Grants for special investigations for which provision may not otherwise be made.

4. The grant of scholarships with a view to the increase of the number of men fully qualified to undertake agricultural research.

5. The carrying out of investigations into problems of local importance, especially those involving the application of modern research to local practice, and the provision of scientific advice for farmers on important technical questions.

SUBJECTS OF RESEARCH.

In making arrangements for the separate investigation, as far as possible, of each group of allied subjects the Commissioners and the Board have been impressed with the importance of securing continuity in work which is necessarily of considerable duration, and at the same time of providing staffs of specialists and experts who will be permanently engaged on work arising from the investigation of the same group of problems. By this means concentration and economy of effort will be better secured than it would be if a number of institutions were dealing at the same time with the same group of problems.

It is neither desirable nor possible to prevent all overlapping or duplication of work, but it is obviously necessary to proceed on a plan by which research work subsidized from public funds will not be unnecessarily duplicated. It is also desirable to arrange that each problem shall be undertaken by the institution best fitted to deal with it, and usually by the institution which has specially devoted its attention to problems of an allied nature. It is also important to avoid the giving of undue attention to one part of the field of agricultural research, to the exclusion of other parts which are of equal scientific and economic importance.

With these considerations in view, it has been arranged that grants should be made for research in the following groups of subjects :—

1. Plant Physiology.
2. Plant Pathology and Mycology.
3. Plant Breeding.
4. Fruit Growing, including the practical treatment of plant diseases.
5. Plant Nutrition and soil Problems.
6. Animal Nutrition.
7. Animal Breeding.
8. Animal Pathology.
9. Dairying.
10. Agricultural Zoology.
11. Economics of Agriculture.

SPECIAL GRANTS FOR RESEARCH.

A sum not exceeding £3,000 per annum will be available for assistance in respect of special investigations for which provision is not otherwise made.

Grants from this fund will be made on the recommendation of the Board's Advisory Committee on Agricultural Science, who will consider not only whether the proposed investigation is desirable in itself, but whether it could not be better carried out at one of the special research institutions referred to above. The grants will be made from year to year, and will be for one year only in each case,

SCHOLARSHIPS.

In order to secure the services of a number of carefully trained men for work in connexion with the scheme, the Board propose in each of the years 1911, 1912, and 1913 to offer 12 scholarships, of the value of £150 per annum, tenable for three years. It is proposed that candidates for scholarships should be selected by a special committee representing the institutions under whom the selected candidates will subsequently work. The award of 12 scholarships will be conditional on a sufficient number of thoroughly suitable candidates presenting themselves.

LOCAL ADVICE AND INVESTIGATIONS.

Grants will also be made to certain Universities, University Colleges, and Agricultural Colleges in England and Wales for the purpose of enabling them to supply scientific advice to farmers on important technical questions and to carry out investigations into problems of local interest, which can be more conveniently studied on the spot than at one of the research institutions.

By means of these grants it is hoped to provide an expert staff possessing both scientific and practical qualifications, who will devote themselves to solving difficult local problems, and in other ways endeavour to secure the application of science to practice.

GUMS, RESINS, SAPS AND EXUDATIONS.

SOME STRAY NOTES ON SAPIUM.

BY EDGAR BECKETT.

(From the *Journal of the Royal Agricultural and Commercial Society of British Guiana*, Vol. 1, No. 2, July, 1911.)

There is not much doubt that there is yet a great amount of information to be gained concerning this genus of our indigenous rubber plants.

That there are large numbers of Sapiums to be found growing in our forests, at scattered intervals, is well known, that this tree is also to be found growing vigorously along the Coast lands is also a fact, but that we know the nomenclature correctly is probably open to doubt, whilst as to the behaviour of the tree under tapping operations and of its merits as compared with *Hevea brasiliensis* we may quote from Prof. Harrison's and Mr. Stockdale's interesting article in the October issue, 1910, of the *Journal* of the Board of Agriculture. "Without therefore pledging ourselves to any definite statement," they write, "in regard to the relative merits of the Para rubber tree and the indigenous Sapium, we are inclined to the opinion that, whereas the value of *Hevea brasiliensis* as a rubber-producing tree under cultivation is known in many countries and under different conditions, that of *Sapium Jenmani* has yet to be definitely ascertained ; and whereas the growth of Para rubber has been satisfactory in a very large number of different localities in the Colony, cultivators would be wise to choose this variety and to consider Sapium as still being in the experimental stage—worthy of trial only on a small scale until more definite information is available in regard to the yields of rubber that can be obtained from it." In the April number for this year, the *Journal* contains the following : "Mr. Stockdale reported on the experimental tappings of *Sapium Jen-*

mani at Bonasika. The experiments were not complete, but the result showed that the planting of *Sapium* could not be recommended if Para rubber was available."

But apart from these considerations, mention of a few of the characteristics of the plant may not be out of place at this juncture, when every tongue runs riot with the name of rubber.

All Sapium leaves bear the distinct character of two glands on the petiole or leaf stalk; in some cases they are very conspicuous, being of considerable length, whilst, in other cases, they are just barely indicated to the naked eye. The margins of the leaves are, some varieties, serrated, and, in others, smooth, with a gland or two of some prominence. On good authority the writer is informed that both the serrated and smooth margins are to be found on leaves of the same tree.

The flowers are very small and are grown on long spikes, the females being at the bottom and the males at the top, the latter generally being also produced in larger numbers than the former. The fruit consists of a small capsule or seed case, not conspicuous at all, and each capsule generally contains three divisions, and, when ripe, splits open, when the seed itself is disclosed, which upon examination is shown to possess a bright arillode, which, in all probability, proves an attraction to birds, insects and rodents. The small size of these seeds is responsible for the idea that used to prevail amongst the Indians that the tree never produced seed at any time. That there is a considerable variety in shape and size of the leaf can be seen by a glance, and this variability appears to be governed apart from distinction of species, by the age of the tree, the position of the leaves and other conditions. A prominent characteristic of one species of Sapium is a distinct hooked gland at the apex of the leaf, but this distinction is said not to be confined to the species indigenous to this Colony alone, as it is found in many species not indigenous to British Guiana. This tree is known to us generally as *Sapium aucuparium*, but according to Mon. Huber is referred to as *Sapium Helmsleyanum*. Of this variety Mr. A. W. Bartlett writes: "The leaves show very considerable variety as to size and shape both in those occurring in different parts of the same tree, at different ages of the plant and on different individuals." This may be said with accuracy in relation to other species of Sapium. He continues: "Thus the leaves on the lowermost branches of some of the trees are destitute of the hooked apex and end in a long blunt point as in *S. Jenmani.* Also the leaves of the young plants and of saplings even measuring 15 to 20 feet are invariably wanting in the characteristic feature." It is obviously, therefore, a risky proceeding to attempt to identify any Sapium by examining a few leaves only.

It is generally taken as an accepted fact that most of the Sapiums of the coast region yield no rubber, but only an inferior quality of resinous latex, yet on the islands at the mouth of the Essequebo river, such as Liberty Island, Fort Island, etc., Sapiums are to be found freely growing "wild," and they do yield rubber, which is said to be equal to that obtained from the Sapiums of the interior. Furthermore, the name *Sapium Jenmani* appears to have been applied somewhat hastily to all rubber-yielding Sapiums. The Sapiums growing in these Essequibo islands may not be *S. Jenmani* at all, but probably will have to, in their turn, undergo the "martyrdom of christening." As to the other indigenous species, *Sapium biglandulosum* is a coast lover, and yields no rubber, while *S. paucinervum* is found to occur in the Pomeroon and in the North-Western District as well as other portions of the colony, and also in all probability furnishes nothing but an inferior resinous, sticky substance, of no value whatever.

S. Helmsleyanum, to give the so-called *S. aucuparium*, the name to which M. Huber has referred it, is distributed widely throughout the Colony, and proves very attractive to boys, for it is chiefly to this tree, though other species yielding resinous products are also utilised, that they have resource when they wish to snare birds. Usually the tree is hacked, and as the latex gushes out it is caught on a stick to which has been rolled portions of bread crumbs, moistened with a liberal supply of saliva. The whole is then smeared over the stick and the snare set "at right angles" to a long bamboo pole which is stuck in the middle of a pasture or other likely spot. So effective is this snare that frequently the active and sturdy vicious little parroquet, known locally as the Keri-Keri, is firmly entrapped by this adhesive mixture, when it has alighted on one of the numerous perches jutting from a bamboo stem.

As to the identity of the tree, a footnote by Mr. Bartlett, in a paper of his on our local rubber trees, throws considerable light.

It is as follows: "In a copy of a paper I have just received through the kindness of Monsieur J. Huber, of the Para Museum, entitled 'Revue Critique des Especes du genre Sapium,' I observe that our specimens identified as *Sapium aucuparium*, Jacq., have been referred to a new species *S. Helmsleyanum Huber*." Now Mr. Bartlett quotes Dr. Huber as writing of Para rubber as follows: "Little of it (Para rubber) is pure Hevea rubber, but usually a mixture of the latices of *H. braziliensis* and *Sapium aucuparium*. The rubber of *S. aucuparium* has never been marked alone, and very little can be said definitely of its value. But when mixed with Hevea latex a rubber is produced not to be distinguished from the supposed pure Hevea rubber."

Mr. Bartlett brought forward two theories, in 1907, to reconcile these different experiences as to the latex of the so-called local *S. aucuparium*, viz., either that the species was different, or to quote this authority "more than one distinct species have been included under this name." or that the trees yielding resin in this colony on our coastlands were only comparatively young trees.

It is a well-known fact, of course, that if we except *Hevea brasiliensis*, many rubber-producing trees yield, when they are young, poor quality resins rather than caoutchouc.

At any rate sufficient has been said to show that it is important that there should be no confusion concerning the identity of this tree.

But the question of the resinous quality of the latex furnished by trees known to yield rubber of good quality when they have attained a number of years, brings us to that which naturally is now arising. Do the so-called *S. Jenmani* yield rubber at a sufficiently early stage of growth to make planting Sapium rubber-growing a commercial undertaking? Have we to wait for five or fifty years before a product comparatively rich in rubber and poor in resin is obtained? These are questions which we should very much like to see definitely settled, while the provoking variability of the genus itself also pleads for a nomenclature, the definiteness of which may give the answer to many puzzling conditions.

As its available characteristics, I may mention that, recently in the North-Western District, I found a *Sapium sp.* with a twisting, tortuous stem, which was hugging in its vice-like grip one of our native palms, in an embrace which must prove to be one of death, so far as the unfortunate palm is concerned.

One would have been certain that this cruel habit belonged to a native *Ficus*, but the leaves proved the tree to be a Sapium, and one which yielded a thick-creamy latex apparently rich in caoutchouc and quite different from the sticky substance furnished by our *Ficus* and non-rubber yielding *Sapiums*.

To return to the question of the mixing of latices of *S. aucuparium* and *Hevea brasiliensis*, it might prove of interest to carry out some experiments with the mixing of the latex of *Sapium Jenmani* and other rubber-yielding Sapiums with that of *Hevea brasiliensis*.

Quite recently the writer was told of a case where the latex of *Hevea brasiliensis* was mixed with the thick yellowish latex of one of our indigenous *Heveas*, (possibly *H. confusa*), with the result that the product was very favourably reported on in England.

In the Aruka valley of the North-Western District the conditions are exceptionally suited to *Sapium* growing. There the tree makes most amazing growth on the soft pegassy lands of the district. On the other hand this peat soil does not support *Hevea brasiliensis* satisfactorily, though where it is mixed with the clay sub-soils the growth of this tree is fair, such as on the dams that have been thrown up when trench digging operations have been carried out. On the heavy clays of the coastlands rubber-yielding Sapiums are, apparently, a failure. They are attacked by scale (*Lecanium* chiefly) and make poor and stunted growth.

A noticeable characteristic of some of our Sapiums, frequently even in the case of trees growing in the interior, is the dying back of the topmost branches.

As to the product, it has been proved that some of our wild Sapium trees yield a rubber which can command a price, when cleanly prepared, very little below fine hard Para.

In the North-Western District considerable progress has been made with the planting of Sapium trees, this activity being due chiefly to the pioneer efforts of the late Mr. David Young. As the trees planted by Mr. Young must have, in many instances, attained some six years, possibly we shall be shortly in a position to know something definite concerning the yields and the quality of the product obtained from trees at an age when Para rubber is tappable.

Until information as to the yield and quality obtained from cultivated Sapiums is forthcoming, there does not appear to be much probability of many more estates undertaking any such cultivation extensively.

RUBBER WORLD REMAINS INTERESTING.

MILLIONS OF POUNDS INVESTED AND ALL PAYING GOOD DIVIDENDS—ESTIMATE 800 POUNDS TO EVERY ACRE.

(From the *Manila Bulletin.*)

That the position in the rubber world is still an interesting one will be readily conceded. Without aspiring to the role of the prophet—a thankless position and one that we should be loth to assume—those who are well qualified to know look for an average price for plantation rubber for the current year of probably not inferior to 5s. 6d. per lb. We need scarcely remark that for the bulk of the producing companies this could not be otherwise than a very satisfactory price, the result of which should be that very good dividends would be earned. On just how much of the forty to fifty millions sterling that has now been embarked in the plantation industry the world over dividends will be paid is beyond us to state. But there will undoubtedly be many companies added to the list of dividend payers, whilst the older ones will have ample balance of which to dispose. The result is that many shareholders are naturally concerned with the attitude that will be assumed by the Boards of Companies as to the policy of dividends fairly liberally, or of retaining large sums, or of allocating a good slice of profits to the creation of reserve funds against the day when the profits cannot in the ordinary nature of things economic, be as large as at present. In an interesting communication Mr. A. S. Baxendale controverts the necessity for the building up of large reserve funds. Shareholders, knowing that they will receive 12 to 15 per cent., with as good security as an investment other than rubber yielding more than 6 per cent. would give, naturally object to the earned profits being withheld. Few who know will quarrel with the statement he makes as follows:—All will agree that a reserve fund equivalent to the capital of the company is desirable, not only in rubber, but in all other companies, and a very fair start has already been made by the best companies, but I trust and believe the view that appropriations to reserve should be proportionate to the dividends will not meet with general support, as the only argument in its favour would seem to be that rubber shares would then afford a more attractive security for those who know nothing about the value of the property of the company. The requirements for a reserve fund in a rubber venture are not so imperative as they are in mines and in most industrial enterprises where much more may be lost in bad years than is probable would be the case with rubber estates. The best course to assume is probably a medium one. Dividends should be paid on fairly liberal basis, and the individual shareholder can make what provision he himself considers prudent. A moderate provision to reserve is all that is necessary; a sum sufficient, that is to place the estate in the best fighting position a few years hence to meet the fall, whether it be to 2s. 6d. or 1s. 6d. gross selling price. In this respect a thoroughly equipped estate, with its buildings and factories all in good order, and its area compact and clean so that it can produce at the lowest rate is likely to fare better than one of double its planted acreage which is not in perfect condition. To achieve this, it does not seem that more than moderate provision need now be made, whilst a few more acres can be brought forward and thus reduce the capital cost per acre as shown by the balance sheet. To remain in the dividend paying list a few years hence means that up-to-date appliances are absolutely necessary. Present profits can provide these. One statement recently made is that the smoking process drives off most of the surplus water, leaving the rubber some 90 per cent. fine, containing a little more water than the present style of dried sheet does, and therefore according to many authorities, possessing more resiliency than ordinary dried sheet can ever aspire to. Rapidly drying by means of a drying chamber, through which perfectly dry air is drawn by means of a fan (the air rendered anhydrous by some cheap desiccator, such as lime or calcium chloride, &c.) is the only sound method, states one authority.

We may, perhaps, before closing, call attention to one or two—shall we say comforting, or optimistic?—statements made by Mr. Baxendale in the letter referred to. As regards labour and its increase in cost, suppose, with an increase of wages amounting to 33 per cent. on an estate entirely composed of 10 years' old rubber, the cost of collection would still be about one-half the cost of collection on the same estate when it was five years old, owing to the fact that the yield of the older trees is at least four times as great, and, roughly speaking, a coolie can tap as many old as young trees. An increase of 33 per cent. in wages would be sufficient to attract

literally tens of thousands of Chinese coolies from other industries to the rubber estates. He goes on to point out that if we cast aside all "make believe" and base our figures on actual experience [which shows us that every acre of rubber of nine years of age produces at least 800 lbs. of rubber,] and if we take the average output of an acre from its tenth till its seventeenth year at 1,000 lbs. a year, we will find that the fair price for an acre of rubber on a seven years' purchase basis would be £875, even if the average price realised did not exceed 3s. a lb. I am convinced that if the world's supply of rubber could be suddenly and permanently increased from 85,000 to 200,000 tons in the course of this year, the average price next year would not be much below 3s. whereas in existing condition, and so long as the supply of rubber is so comparatively insufficient for all needs as to lend itself to manipulation, the sudden disclosure of 10,000 tons of hidden stocks would paralyse the market for months. Mr. Baxendale is referring only to properties in the Federated Malay States and not even the Province Wellesley or Malacca. If his facts are accurate for that district, we see no reason to doubt that certainly in Sumatra, and possibly in Borneo many states may be able to do equally as well.

NEW RUBBER ENTERPRISE.

COMPANY BEING ORGANIZED IN MANILA TO OPERATE IN MINDORO—EXPECT TO SECURE AID OF AMERICAN CAPITAL.

(From the *Manila Bulletin.*)

Another enterprise is being launched in Manila to develope rubber possibilities in the island of Mindoro.

The enterprise is headed by Manila capitalists, who have already made a good beginning, but expect to secure American capital to aid them in the final success of the undertaking.

The company has secured 2,500 acres of excellent land in Mindoro situated on the Paco River and has as a beginning several thousand trees that were planted about three years ago in nursery, but which were never transplanted and have reached a height of from thirty to forty feet, but are stunted to some degree in girth, due to lack of room for greater growth by never having been transplanted.

According to the Bureau of Agriculture and rubber experts these trees can be transplanted even at this date and will do well, and they will form a nucleus around which the plantation will be installed and developed. The trees in question were planted by Mr. E. C. Hamil, who after planting the nursery left for the gold fields of Paracale and never paid further attention to them until only recently when it was discovered that they were valuable, the trees being of the Para rubber quality.

The new company is being organized by Manilans, Mr. T. D. Aitken, the well-known attorney being one of the principals in the enterprise, and it is most likely that Messrs. Birkett and Holden will act as treasurers.

It is expected that the organization will be completed within the next few days, and work on the plantation, clearing up the land and transplanting the trees will begin immediately.

OILS AND FATS.

CITRONELLA OIL STANDARD.

(From the *Chemist and Druggist*, No. 1, 649, Vol. LXXIX., September 2, 1911.)

Mr. John C. Umney, F.C.S., in the course of an Editorial on this subject in the "Perfumery and Essential Oil Record" for August, submits details of the characters and tests for the purity and odour-value of the oil. Mr. E. J. Parry and the analytical chemists of several of the largest soap-manufacturers have co-operated with him, and to judge of the accuracy of the assay process, sealed samples from the same bulk have been examined by himself and each of the analysts. The maximum difference in geraniol from highest to lowest was found not to exceed 0·5 per cent., which is certainly sufficiently close for all commercial purposes. Critisism and comment upon these characters and the tests and their working are invited.

They are as follows :—

Sp. gr. at $\frac{15 \cdot 5^\circ C}{15 \cdot 5^\circ C}$ ... 0·898 to 0·910
Optical rotation ... -7° to -13°
Acidity expressed as acetic acid Not above 0·25 per cent.
Soluble in 2-3 vols. of 80 per cent. by vol. alcohol, and clear on further addition of the alcohol up to 10 vols.
Acetylisable consitituents stated as geraniol, at least 58 per cent.

Estimation of Geraniol.—Ten c.c. of the oil with 15 c.c. of acetic anhydride (Note 1) and 1 gram of anhydrous sodium acetate are boiled for two hours under a reflux condenser. The mixture is cooled without removing the flask from the condenser, and about 50 c.c. of water is slowly added through the condenser tube. The contents of the flask are heated to not more than 70° C. for about twenty minutes, poured into a separating funnel, and washed with cold neutral brine (Note 2) until all soluble acid is removed. The washed acetylated product is dried with anhydrous neutral sodium sulphate, and from 2·5 to 5 grams saponified with alcoholic potash in the usual way. Any free acidity is neutralised before measuring the volume of decinormal KOH, and saponification is completed by heating on a boiling water-bath for forty-five minutes. The excess of KOH is titrated with decinormal acid.

The acetic anhydride should contain at least 95 per cent. of actual anhydride, and be free from higher homologues. Water may be used instead of brine, but the latter is to be preferred, as it separates more rapidly from the oil.

FIBRES.

THE PHILIPPINES AND THE BAMBOO.

(From the *Manila Bulletin.*)

The Philippines is interested in the development of the manufacture of pulp for paper out of the bamboo, and the following from the *Literary Digest* on recent developments is worth reading. It will also be noted that no reference is made to the Philippines as a source of bamboo pulp, while Porto Rico and the Panama zone are set forth as the only American territory where bamboo is available. The *Digest* says :—

Our Vanishing Forests of spruce, cut down to supply the enormous demand for print-paper, may find relief in the discovery of a new source of supply in the tropics. Bamboo pulp is likely to come to the front as a main source of paper stock supply according to an article contributed to American Forestry (June) by Harry Vincent, who quotes *The World's Paper Trade Review* (London) as his authority. The difficulty heretofore has been in the bleaching, as the colouring matter could not be eliminated except by the expensive causcic-soda process. This has now been obviated. Bamboo has incontestable advantages over other pulp material. A piece of land once established can be cut over annually for an indefinite period, as bamboo in the tropics grows thirty feet or more yearly. As it requires but a three-year period to establish a field, no other material can compete with it. The United States has control over large territories in Porto Rico and the Panama Zone most suitable for bamboo cultivation, and a permanent future supply up to millions of tons a year may be assured, the writer thinks. We read :—

"The advantages of bamboo as a pulp-maker are : (1) It has a good, strong vegetable fibre ; (2) it is in general easily accesible for water transport ; (3) it is cheap and easily collected ; (4) it is available in large quantities and abundant within a given area ; (5) it is avaiiable for a regular and constant supply, and not subject to violent fluctuations either in quality or price ; (6) it admits of simple and ready treatment, mechanical, chemical, or both, for easy and inexpensive conversion into bleached pulp ; (7) land established in bamboo, which will take three years from first planting to reach a height of thirty to forty feet, can then be reaped annually for an indefinite period.

"Ordinary thick walled bamboo which, when given suitable soil and climate, grows with amazing rapidity and yields annually at least forty tons to the acre, contains fifty per cent. of a very strong yet fine and flexible fibre, easily digested by the ordinary bisulphide process, and by a new method simply and inexpensively bleached, yielding when properly treated an excellent pulp, felting readily, and producing a paper, pliant, resistant and opaque, of enduring colour, thicker than other paper of the same weight,

and forming one of the very finest of materials for writing and printing, and of exceptional value for engraving."

Commenting on Mr. Vincent's article, the editor of American Forestry notes that the proposal to use bamboo for paper is an incident of the search for pulp-material to meet the great and growing demand. He says:—

"The increasing scarcity and cost of spruce has already led to successful experiments with other woods, formerly disregarded, but experimenters are continually looking for material which can be grown more rapidly than trees. The foregoing article suggests a possible promising source of supply, but it must be remembered that bamboo is a tropical product, and that our mills, representing an enormous investment, are in the North. The utilization of bamboo on a large commercial scale would involve a considerable readjustment of the pulp industry, and the solving of many questions, among which that of labour would not be the least. It can, therefore, hardly be regarded as a possibility of the immediate future, although well worth consideration in connection with an ultimate supply,"

EDIBLE PRODUCTS.

PADDY CULTIVATION IN CEYLON DURING THE XIXTH CENTURY.

BY E. ELLIOTT.

(*Continued from page 312.*)

STATISTICS AND THEIR COMPILATION.

The statements of production of Paddy I have so far given, have, in the absence of reliable statistics, been necessarily deduced from the only trustworthy data available, viz., the sums received annually by Government for its share of the crops. But as I now purpose basing my conclusions on more exact statistics, both of acreage and production, I will explain how and where I got my figures, and my reasons for thinking they are substantially accurate and reliable.

The Government Blue Book Agricultural Returns, as printed and published, have unfortunately not been free from palpable errors, and consequently they have been rather indiscriminately condemned as untrustworthy. This, I have always felt, was too sweeping, and I was sure that, as recently expressed by Mr. Booth, Government Agent, Western Province, "the returns as compiled by the Headmen though not absolutely accurate, were for the most part probably near the mark." I was further of opinion that the absurd figures which occasionally disfigured the published returns were most probably attributable to the carelessness of the subsequent clerical compilers in the Kachcheries, and possibly to printer's errors, to which undue prominence has been given.

Accordingly, some years ago, while in Ceylon, I had the Blue Book figures for the acreage and production of Paddy in each district for the twenty-six years, 1866 to 1892, copied on to two big sheets. I was thus able at a glance to compare the figures over the whole period for each and 'spot' any extraordinary figures, and refer to the various Kachcheries for explanation. Curiously enough, I found, I think, only one serious error as regards acreage, where the number of bushels sowing extent in the North-Western Province, as returned by the Headmen, was given instead of the equivalent number of acres it was the Kachcheri Clerk's duty to have inserted. But the mistakes as regards production were numerous and varied, but easily discovered, as the very next column of the Blue Book returns gives the rate of production.

This careful scrutiny confirmed the favourable opinion already expressed; and during a recent visit to London I have personally taken out the details, district by district, from the Blue Books for another sixteen years between 1893 and 1910. These appear to have been more carefully compiled, but not to be altogether free from some palpable errors, attributable to clerks or printers.*

Thus, figures for Batticaloa crop in 1901, off some 87,000 acres, was printed

* Thus the addition or omission of a single cypher in some of the details made a difference of three millions in the aggregate crops of 1882 and 1885, which have long figured as the maximum and minimum of the decade, and must in future appear as eight millions odd in each year. A similar palpable mistake in the details of the Northern Province for 1888 justified the elision of nearly a million bushels.

153,188 bushels, though the average rate of productions given in the next column disclosed the omission of the figure for millions. It should have been 1,153,188 plus 383,782 in Trincomalie, making a total of 1,536,970 for the Eastern Province.

Similarly an absurd crop of over seven millions in Kandy was found to be due to the unfortunate addition of that figure at both ends, instead of in the unit place only, possibly ascribable to the proverbial P.D.

As I believe these returns are now checked in the Audit Office, I trust some steps will be taken to prevent the promulgation of such absurd and unjustifiable mistakes in future, which throw discredit and suggest doubts of the correctness of the whole of the figures.

Having cleared away these errors, it remains for me to deal with two other grounds generally advanced for impugning their accuracy, viz., inconsistency with each other and under-estimation. To the former I would reply that these apparent inconsistencies are really evidences of accuracy, and are chiefly attributable to corresponding variations in the rainfall which have been ignored by critics who have not studied its effect, and bearing on a cultivation so dependent on the water supply, as I will further show a few pages hence. As regards *under-estimation* of production; for purposes of comparison it is a negligible quantity; as it equally affects all the figures, but it is not so great as usually alleged, and which I at one time thought myself. Mr. Lewis states (Wanny Manual) that Mr. Fowler thought the Headmen gave two-thirds the proper estimate. I think this is too much, and probably three-fourths would be nearer the mark.

My experience as cultivator has taught me of the very large margins which must be allowed for contingencies, especially when dealing with large areas, in the wilder parts of the Island. Even at the earliest stages there are enemies to ward against as well expressed in a Tamil Proverb, which may be rendered as follows :—

Remember this, when'eer you sow,
One for Crab, and one for Crow,
One to die, and *one to grow*.

Then there are elephants, pigs, crocodiles, besides vast hordes of birds who alone do immense damage, especially to limited or detached cultivations. I have had Rs.200 worth of Paddy destroyed in a night by a few elephants, in spite of a watcher armed with a gun, and half my first crop off a small area was eaten by birds.

Another frequent cause of a low crop return is large sowing, induced by favourable weather in the early stages, especially in the very extensive tracts in Batticaloa. Difficulties arise and delay follows which prevent completion of the sowing in the proper time. The crop then "gets late" and is not ready for reaping with the rest of the tract; and the swarm of birds in the air concentrate their depredations on the still tender crop. The communal fence has however been put up round the whole tract at the time fixed, and must be broken up at the time agreed on beforehand (the sticks being required to protect the stacked crop). Hordes of cattle thus get admission, and the late crop has to be abandoned unreaped. I have known several hundred acres lost in this way in the extensive vattais, (*i.e.*, fields associated for purposes of cultivation) in Batticaloa, in some of which over 1,000 acres lie within one ring fence.

I could multiply the circumstances which have to be taken into consideration in estimating the crops of large tracts, but what I have said will suffice, I trust, to carry conviction and enlist sympathy.

To resume the examination of the returns.

I find that the reported aggregate crop for the whole Island varies in the earlier years from 11½ bushels per acre (in 1872) to 18½ bushels in 1879, but this rise is accounted for by the fact that the rainfall in the former year was 64 inches and in the latter 161; while in 1896 (with a rainfall of 93 inches) it was 19 and in 1904 (with 82) it is given at 20½ bushels. An addition of 25% to these figures would give more than the 8-fold in an ordinary year which Sir C. P. Layard records to be a fair average in the more favoured Western Province with its equable rainfall.

With still more favourable climatic conditions in the Central Province, I find the figures to be 21½ busheds per acre (average of five years 1888-92) and a maximum of 28 bushels in the Kandy district in 1905.

I have been specially impressed with the absence of any "window dressing" of the figures furnished. The largest crop is rarely found against the biggest acreage; and where a good crop is obtained off a moderate sowing, or *vice versa*, it appears to be fairly stated without any cooking of the figures. I

may add that in such cases a reference to the rainfall returns almost invariably bears out the results given.

Under these circumstances I think I may claim for the statistics I am about to deal with, that they are a fair and accurate representation of the progrsss of Paddy cultivation in Ceylon during the last fifty years.

As regards the use of the term "*acreage*" in the Blue Books and in my returns, a word of explanation is necessary. In ordinary parlance and in reference to such crops as Coconuts, Coffee, Tea, etc., it indicates the area planted with these products independent of the number of crops gathered in the year. But in the Blue Book returns for Paddy the practice is different and not always the same. As is well hnown, especially in Matara, a large proportion of the aswedumized or arable area is cropped twice within the twelve months; while in parts of the Western Province three crops are taken off the same parcels of land. In Batticaloa, on the other hand, only a comparatively small proportion (if any) is cultivated twice, and though there are three crops within the year, they are raised on different lands.

In the North-Central Province, also, heretofore no land has been cultivated a second time (as recently reported by the Government Agent). Again; in the Western Province figures, the acreage sown with Paddy for *each* harvest is added together and the total shown, In 1888 this was 68,000 in the Colombo District, whereas the whole aswedumized area is about three-fourths of this. On the other hand, in the Central Province, the area reported as sown never exceeds the arable area, and so I conclude any twice sown land is only taken into account once.

As the extent cultivated a second time within the year is on the increase, especially in the irrigated districts, it is important to get reliable information in this respect. The Headmen who prepare the returns in the first instance might be required to give it. But whether it is so supplied or not, it is necessary to secure uniformity, and therefore desirable that some definite ruling of Government on the point should be promulgated. Meanwhile I draw attention to the matter, as agricultural statisticians are accustomed to deal with acreage as test of progress, and I think it is to this fact may be traced the adverse opinions generally held as to the progress of Paddy cultivation during recent times, and the disappointment that greater extension did not follow on the abolition of the Grain Tax.

Some years ago at an Agricultural Exhibition at Matara, when addressing an audience familiar with the subject, I pointed out how the production of Paddy had been doubled in that district, thanks to Irrigation, with hardly any addition to the arable area. The statement has been, I hear, impugned; it was true at the time; and though owing to probably incessant cultivation there may have been some falling off, I am glad to find that the average crops are still at least 50 % above what they were in pre-irrigation times.

In view of these circumstances it seems to me that the progress and development of Paddy cultivation in Ceylon must be measured by the *increased production* rather than by the additional area brought under cultivation.

The Weather and Rainfall

is another collateral but important subject which calls for attention at this stage. In Rhys David's translation of the first fifty Jatakas, it is recounted how on one occasion "the lion maintained that the dark half of the moon was cold, while the tiger thought it was cold in the moonlight half, neither seeing until the Bodisat told them, that it was not the moon but the wind which brought the cold." And so it has been with the discussions over paddy cultivation; some ascribed the slow development to "the apathy of the native," and others to inferiority of soil, yield, etc. There has been a general idea that water was required in the dry districts and irrigation was necessary, coupled however with doubts "if it would pay." But due regard has not been paid to the rainfall, and especially as, as already stated, much criticism of the reported results ignored its consideration. Irrigation has its usefulness undoubtedly in storing and eking out the rain, but it by no means takes its place, and there is nothing like a plentiful fall to produce bumper crops.

So in my opinion no examination or criticism of the returns of paddy cultivation and production is worthy of acceptance which is not accompanied by a careful reference to the concurrent rainfall. Nor can the ordinary returns in any *calendar* year be used for this purpose. The true agricultural year in Ceylon is the Sinhalese one, and the corresponding rainfall return should be that for the twelve months ending on the 30th April of each year. This would include two complete monsoons and the climatic influehce which govern the two

big crops known as Maha in the Sinhalese and Munmari in the Tamil districts (sown in the second half of the previous year and harvested in the early months of the current one), and the Yala (or Karavelama) sown and harvested within the first eight months of the calendar year, under which the entire figures for both crops are credited in the Blue Book returns.

Unfortunately, I have only access to one rainfall return for a long period, namely, that in Ferguson's invaluable directory, but though this is for Colombo alone, it may I think be accepted as typical of the weather generally, which prevailed throughout the island in each period; and as the fall is given by months, I have been able to recast it on the foregoing lines. I have also found a return of the early rainfall at Mullaittivu, in the Vanny manual, which will serve to show if the Colombo return is approximately correct for the Eastern side of the Island in any year. I find, too, from the diagrams attached to Sir J. Keane's report (LV. 1905) that the average falls during the N.-E. monsoon at Colombo and Batticaloa are very nearly the same, but a month earlier on the Western coast, the heaviest at Colombo in October, and in November at Batticaloa and Trincomalie.

Working on these lines, I have framed a return showing the total average sown in the whole island in each year, the gross estimated production of paddy, the rainfall for each agricultural twelve months ending on 30th April and the comparative strength of each monsoon, as well as the fall in each little monsoon, a governing influence in the cultivation of the later Yala crops in the Sinhalese districts.

An examination of the progress and development which this table discloses will be presently discussed, and here I only purpose considering it in reference to the climatic influences which have conduced to this happy result. First, I would point out how it justifies the official returns and accounts for variations in the figures which have been taken as indicating untrustworthiness.

Thus a small crop of 1873 is fully accounted for by the very short rainfall (62″), the failure of the S.W.* and a moderate N.E. monsoon; while the bumper crop of the seventies was in 1878, when the total fall was 114″ with a good S.W. and a V.H., N.E. But though the fall of the next year was still heavier (151″), the monsoon conditions were somewhat reversed (S.W., V.H. and N.E., M.) Consequently the sowing and crop were both extensive and very good in all the Sinhalese districts, except the North-Western and North-Central Provinces, where, and in the Northern and Eastern Provinces there was a reduction of 50,000 acres in the extent sown; and poor crops in the Tamil districts, but better in the other two provinces, thanks to an early and heavy little monsoon in April, which admitted doubtless of some cultivation for Yala.

I have found the table most useful in the preparation of this paper, and have myself learnt several lessons from it, which though of small use to me now, may prove of value to those now or hereafter entrusted with the care of the interests I have in the past watched and loved so well.

Thus it discloses that it is a *reasonable* and *seasonable* and not a "ranting tanting" fall (such as the proverbial Scotch Divine deprecated) of over 100 inches, which produces the best crops; and that these were not always got off the most extensive sowings. For instance, the largest crop of the eighties (just under ten millions B.P.) were got off a sowing of 585,000 acres, with a rainfall of 90″ (S.W., V.H. and N.E., H.,) while in 1887 a fall of 103 inches (S.W., G. and N.E., M.) only secured a crop of 8 millions.

Making every allowance for the increase in the arable area, another gratifying fact disclosed by this table is that the cultivation of paddy seems to be getting less and less dependent on the Clerk of the Weather, and that irrigation is telling, though of course there are exceptional years when the rainfall is largely deficient or badly distributed. This is especially the case in the Districts largely dependent on the N.E. monsoon, and where the chief irrigation works are situated. Thus, in the Eastern Province the area cultivated for 1905-6 was over 77,000 acres, only 12½ % below the maximum (88,000 in 1904) consequent on the heavy rain (25½ inches) in September and October, 1905, but the young crops were so largely destroyed by the drought* in the following November, (5 inches instead of usual 12), and December (0·48 instead of usual 13) that the outturn was 47 % less.

* The abbreviations are to be read as follows:—S.W., South-West monsoon; N.E., North-East monsoon; V.H., very heavy, H., heavy; G., good; M., moderate; L., light; F., failure; B.P., Bushels of Paddy.

* A considerable area in the Eastern Province is cultivated for the Munmari crop so entirely dependent in the direct rainfall.

In this connection I would point out that the big works in Batticaloa South are dependent for their supply on streams rising in the Badulla hills, only small feeders of which originate within the zone of 100 inches R. F. I would suggest enquiry should be made as to the necessity of reserving any of the forest on the higher hill in this region in the interests of the water supply, as very little of the South-West Monsoon gets into the next zone (of 75 inches). The source of the Magam River which feeds the Tissa Tanks should also be similarly looked to.

The subject decidedly calls for consideration, for whatever its cause the average rainfall has decreased during the last twenty years (subsequent to 1892) as compared with the same period before the abolition of the grain tax. Thus

1908-01...56 Inches.	1889-92...97 Inches.
1903-07...80 ,,	1883-88...87 ,,
1998-02...80 ,,	1878-82...98 ,,
1993-97...83 ,,	1873-77...76 ,,
304	358

Annual Average 76 against (say) 90.

These are of course Colombo figures, and it would be advisable and interesting to see if at other stations, especially where the N.E. monsoon is the predominant contributor, the results are the same.

The last four years of short supply are, however, not unprecedented, as a similar period of deficiency prevailed from 1872 to 1875, following in both cases a very heavy year 118" in 1871 and 114" in 1903, I trust that climate, like history, may repeat itself, and that a wet cycle is now in store for the island.

I hope that the close connection I have pointed out as existing between cultivation of paddy and the rainfall will prevent a repetition of the mistakes made by a writer who under the name of "Speculum" in 1867-8, poked fun at the Government returns. I have gone carefully into his figures, and find that there was nothing very wrong in those he questioned (except such palpable clerical errors as I have eliminated in the later returns), and that the discrepancies he lays stress on were due to the rainfall and the increasing crops at Batticaloa which he overlooked. But I must admit that the explanations given by the high officials, in Council at that time, exhibit similar ignorance of the true causes, and gave ground for further scoffing.

Another instance of questioning the correctness of the Government returns based on apparent inconsistencies occurred during the discussion which followed the reading of my paper on Paddy Cultivation before the Ceylon Branch of the Royal Asiatic Society in 1885, when one speaker based his remarks on the returns of production for the Batticaloa district having fallen from 24 bushels per acre in 1870 to 17 in 1877, 12 in 1883, and 6 in 1884, a statement which it is noted 'raised a laugh.' Unfortunately I was not prepared for an explanation on the spot, but a reference to the rainfall at once supplies the reason, viz., that there was an unusually wet August (1883) nearly 88" at Colombo, and that this induced a very large cultivation—72,649 acres in the Eastern Province; but it was followed by only a moderate fall in October and a considerable failure in November and December, and a perfectly dry January. I was relieved at Batticaloa by Mr. Allanson Bailey, and have a perfect recollection of the unusually dry weather at Xmas 1883, Though this permitted us both to come and go by road comfortably, it was undoubtedly the ruination of the crops, and quite accounts for the low return in 1884.

Coming to later times, I find some oversights of a similar nature in the reports printed in Sess. Paper VI. of 1908. Thus Mr. Booth was at a loss to explain an increase of 7,342 acres in the Alutkuru Korale of the Colombo district of figures for 1907 over those given for 1880-1. If he had referred to the weather reports he would have, I think, hit on the truth, viz., that the rainfall in 1880-81 was only 56 inches (for the agricultural year), while in 1906-7 though the rainfall was only 65 inches, it was well distributed; and as the arable area in Alutkuru Korale was so late as 1888, reported to be 9.855 acres (G.C. returns) a cultivation of 15,334 in 1906-7 points to an extensive second tilling of the same land consequent on a good North-East and an early heavy little Monsoon in April, 1907. At the same time I would deprecate comparisons between single years.

I could múltiply instances, but I think those given will show that as in the days of the Lion and Tiger of the Jatakas, a modern friendly Bodisat may still be useful to elucidate such differences of opinion and attribute them to the more probable source. I trust that my efforts in this direction may be found useful as regards paddy, and be generally accepted as more in accordance with modern views, than I fear the original decision of the Bodisat in the case quoted would be considered in these days.

(To be continued.)

COCONUT GROWING IN THE PHILIPPINE ISLANDS.

GENERAL STATEMENT.

(From the *War Department Bureau of Insular Affairs, 1911.*)

After fifteen years of observation on the ground in the Philippines, I have reached the conclusion that no branch of agriculture there offers such certainty of steady and assured returns from comparatively small investment as does the growing of coconuts, which may be raised to advantage as far north as Pangasinan, La Union and South and North Ilocos, and flourish in the Southern Philippines to a degree nowhere excelled and seldom equalled in other countries.

I have found it extremely difficult to obtain really reliable information as to cost of production and average annual value of crop. As a rule the Filipino has the vaguest ideas on these subjects; one man will tell you that his trees average ten nuts per year, while another will solemnly assure you that fairly good trees produce three or four hundred. The same lack of accurate knowledge is encountered when one endeavours to ascertain the cost of planting catch crops among the young trees and the presumable profits to be derived therefrom. It has, therefore, taken a very long time to gather the information which follows, but I believe that it is reasonably reliable, and that the conclusions which I draw from it are conservative.

THE SELECTION OF SITES FOR COCONUT PLANTATIONS.

Soil and climatic conditions in many parts of the Philippines are ideal for coconut production. It should be remembered that the agricultural methods of the natives have violated every known rule. Seldom has the ground been really properly prepared for planting. The trees invariably stand too thickly. The Filipino cannot rid himself of the idea that the more seed he sows the greater will be his harvest. This theory, when applied to coconuts, results in the production of tall, spindling trees, producing half the number of leaves they ought to have, and bearing nuts sparingly, if at all. It is a marked case of a hard struggle for existence, and the trees which lose out are often barren for years before they ultimately die, yet it is usually impossible to convince the owner of a plantation which is suffering from too close planting that he would be much better off were he to cut down half or two-thirds of his trees, selecting for elimination those which produce few or no nuts.

On the existing plantations trees frequently stand within ten feet of each other, or less, whereas thirty feet should be the minimum distance from tree to tree. As a rule, little effort is made to keep the ground under the trees free from brush after they reach the producing age, and it is by no means unusual to find forest trees competing successfully with coconut palms for light and air. Dead leaves are not removed, but are allowed to hang until they fall, and then slowly to rot on the ground. No effort is made to stop the depredations of the rhinoceros beetle, which in some regions is fairly abundant. In order to facilitate climbing, notches are carelessly cut into the bark of tender trees, often extending through into the wood. Wherever the lower surface of such a notch slants inward, water stands in it, and this causes rotting of the wood. The vast majority of native coconut plantations suffer severely and needlessly from this cause. If those who gather the nuts were provided with the climbers used by linemen in ascending telegraph poles, they could go up and down the trees easily and safely without doing them the slightest injury. If notches must be cut, they should at least have their lower surfaces inclined downward and outward so that water will not stand in them, and great care should be taken not to cut through the bark.

The present owners of coconut groves often neglect to harvest their nuts, which are allowed to fall and lie around on the ground. It is seldom indeed that effective means are taken to check the depredations of fruit bats, crows and monkeys, or to disturb the rats which not infrequently nest at the bases of the leaves and help themselves to the fruit.

There are many very extensive plantations which produce no nuts at all, for the reason that their owners prefer to tap the blossom stalk and make from the juice thus obtained a fermented drink known as "tuba."

Only in the rarest instances is any attention paid to seed selection, yet in spite of this carelessness and neglect the Philippine Islands produced during the fiscal year ended June 30, 1909, some 1,658,724 piculs, or approximately 231,787,050 pounds of copra, or dried coconut meat. This output excels that of Java, of the Straits Settlements, of Ceylon, or of the South Sea Islands, and places the Philippines at the head of

the list of coconut growing countries. In fact, during the year mentioned the Philippines produced about one-third of the world's output.

A large amount of copra is consumed locally. During the year in question 232,728,116 pounds of copra, valued at $6,650,740, and 364 788 gallons of coconut oil, valued at $157,916, were exported. If this result has been obtained under the haphazard methods in vogue what may be anticipated when due care is exercised in selecting suitable land, when it is properly cleared and planted, and when suitable cultivation is continued while the young trees are growing and after they begin to produce?

Soil and climatic conditions vary greatly in different parts of the Philippines, and it is important in selecting a site for a plantation to know what to seek and what to avoid. Most authorities are agreed that a stiff, clayey soil is not favourable to coconut production, but I have seen perfect trees, bearing one hundred or more splendid nuts each, growing in precisely this kind of soil. It is, of course, possible that there may have been an underlying layer of more friable and permeable soil, but the existence of these magnificent trees growing in clay conclusively demonstrates the fact that it is unsafe to conclude, from apparently unfavourable surface indications, that a given piece of land may not produce coconuts to great advantage.

Other authorities inveigh against a very sandy soil as being unsuited to coconut growing, and go so far as to state that every grain of sand in excess of what is required to make the soil fairly permeable to water is a positive detriment, yet the finest coconut trees that I have ever seen stood in pure beach sand, so poor that it would hardly grow either grass or weeds, and so destitute of plant-food that a careful chemical analysis failed to reveal the presence of any at all!

Trees growing in sand close to the sea naturally never lack for water, and all authorities are agreed that coconut trees need an abundant supply of water at all times. It is equally certain that they are prejudiced by the presence, in their immediate vicinity of *stagnant* water, while in cases where the permanent water-table comes very near the surface of the ground their roots spread out just above it with the result that they fail to grasp the earth firmly and the trees are readily blown down by violent winds.

The saying so common among natives of coconut-producing countries that the trees will not flourish unless they can *see* or *hear* the waves of the ocean undoubtedly rests on a solid basis of fact. The greater the volume of water which daily flows up through the stem of the tree and evaporates from its leaves, the more rapid and vigorous the growth of the tree and the greater its productivity. Evaporation being intimately associated with the free circulation of air, it follows that sites which are fully exposed to the prevailing winds are best, unless those winds are so violent as to injure the leaves and dislodge the young nuts. Cocenuts should, therefore, never be planted in inclosed and sheltered valleys, but the site selected for a plantation should be along the coast or on some open plain where the circulation of air will be impeded as little as possible. Regions which have especially well-marked wet and dry seasons are not favourable to coconut production, especially if the dry season be of long duration. While coconut trees are seldom killed by such droughts as occur in the Philippines, the production of nuts is often temporarily checked by drought in provinces where the dry season is especially long and severe.

There are regions in the Philippines where rain usually falls during every month of the year, and they are especially favourable for coconut production. Rain maps of the Philippines, showing for each month of the year the rainfall conditions throughout the Archipelago, so far as they are known, may be seen at the Manila Observatory, and information relative to the distribution and amount of rainfall in any particular region will be gladly furnished, if available, by Father José Algue, the Director of the Weather Bureau. It will be found that there are many regions where conditions as regards rainfall leave nothing to be desired.

While the coconut palm is admirably adapted by nature to resist severe wind storms, and when standing in suitable ground is seldom uprooted by the most violent gales, severe typhoons will sometimes blow all of the nuts off trees, at the same time destroying the blossoms, so that the resumption of fruiting will be delayed for a considerable period, while the violent whipping about to which the leaves are subjected in these very severe storms injures them even if it does not serve to detach them from the trees.

While typhoons do not prevent the profitable growing of coconuts through-

out the Islands, there are extensive regions in Mindanao, Palawan, and the intervening southern islands where these storms are practically unknown, and it is well, in selecting a site for a plantation, to eliminate possible loss from this source by first studying the storm maps of the Philippines and selecting a region where typhoons seldom if ever occur.

In considering soil conditions, one should remember the old saying that *the proof of the pudding is in the eating.* Owing to the haphazard cultivation methods which have been followed, adult trees, demonstrating fully the capabilities of the soil to produce coconuts without cultivation, may be found in the vicinity of almost any available tract of land, and it is safer to consider *facts* than to be swayed by *theories.* However, it can be stated with entire certainty that soil conditions on the numerous flat-topped coral islands rising only ten or fifteen feet above sea level are most satisfactory. On such islands the permanent water-table lies near enough the surface of the ground, so that the roots of coconut trees readily reach it, and the possibility of harm from drought is completely eliminated. The soil is so poor in the food required by ordinary plants and weeds that comparatively little cultivation is required to keep it clean. Mosquitoes do not exist on such islands as there is no opportunity for them to breed, and in general health conditions are ideal. Proximity to the sea insures that free circulation of air which is essential, and incidentally the complete absence of wild hogs does away with the necessity for fencing. The majority of those islands are uninhabited and the absence of human thieves is a factor of no small importance.

Insect pests, which are sometimes to be feared on the mainland of the larger islands, are also conspicuous by their absence, as are monkeys.

Cost of Land and Amount of Suitable Land Available for Coconut Growing.

It is sometimes possible to purchase from private persons land suitable for coconut growing, but it will usually be found more advantageous to purchase or lease from the Government. Under the provisions of existing law, an individual may not purchase more than 16 hectares (40) acres) of public land. A corporation may purchase 1,024 hectares (2,500 acres), but if authorized to engage in agriculture must, by its charter, be limited to the ownership and control of this amount of land, and persons who are members of a corporation authorized to engage in agriculture may not be members of any other corporation so authorized. The minimum price at which public land may be sold is 10 pesos per hectare ($2·00 per acre). In selling wild public land it is the custom of the Insular Government to charge the minimum price. Actual title to the land may not pass until after five years of occupation and cultivation. Payment may be made as follows: twenty-five per centum at the time the bid is submitted; the balance upon the making of the award; or it may be paid in one instalment at the expiration of five years from the date of the award. Sums remaining unpaid after the date of the award bear interest at the rate of six per centum per annum from such date until paid,

The provisions as to leasing are more satisfactory. Either an individual or a corporation may lease not to exceed 1,024 hectares (2,500 acres). Leases run for twenty-five years with the right of renewal for an additional twenty-five years. The rental during the first period of twenty-five years may not be *less* than 10 cents per acre per year, and during the second period of twenty-five years it may not be *more* than 30 cents per acre per year. The rental is payable annually in advance.

There are in the Philippine Islands very extensive areas of unoccupied unclaimed public land suitable for coconut growing. Such land is especially abundant in Mindoro, Mindanao, Palawan, and the small islands adjacent to Palawan. Some of the latter offer very many advantages, such as the lack of necessity for fencing against wild hogs; the absence of monkeys; the absence of undesirable human neighbours; freedom from insect pests; free access to all winds; a permeable soil especially suited for coconut growing, and the presence of the permanent water-table near enough the surface of the ground to make it certain that there will be no harmful results from drought after the trees are once well established.

The chief drawbacks are isolation and the absence of fresh water, which is lacking on the smaller islands. Rain water, sufficient for all domestic purposes, may, however, readily be caught. These islands vary greatly in size. A number of them have been already surveyed in connection with work necessary in surveying for several lease applications, and information as to their whereabouts and extent, and as to the whereabouts of land suitable for coconut growing on the larger islands above referred to,

will be gladly given by the Director of Lands, or by the Secretary of the Interior.

TAXES.

In the provinces organized under the regular provincial government act, taxes on land and improvements thereon (by "improvements" are meant *buildings*, not growing crops or coconut trees) may not exceed seven-eighths of one per centum per annum, on what is estimated to be the true sale value of the property. In the provinces organized under the special provincial government act, namely, the Mountain Province and Nueva Vizcaya in Northern Luzon, Mindoro, Palawan, and Agusan Province in the Island of Mindanao, taxes are one-half of one per centum per annum on the value of all real estate and personal property in excess of $100·00. In the latter provinces, therefore, coconut trees are taxable. They are usually appraised at $0·50 to $1·00 each. In the Moro Province the taxes are three-fourths of one per centum per annum on the value of all personal property, and real estate, including improvements thereon. Re-valuations are made once in five years.

It is needless to say that the above remarks apply only to land which is actually owned by individuals and to the improvements thereon. Land which is rented from the Government is not subject to taxation, but the improvements on it are.

COST OF CLEARING FOREST AND BRUSH LAND.

The net cost of clearing forest land (by clearing is meant leaving it ready for planting) will obviously vary with the character of the forest, which may be such as to involve a larger or smaller amount of work in felling and burning trees, stumping, etc., and may give a larger or smaller return from merchantable timber and firewood. The following figures are given by Mr. C. H. Lamb, Superintendent of the Iwahig Penal Colony, and are based on large experience. Mr. Lamb keeps strict account of all labour employed and charges it up at a daily wage of $0·25.

Felling trees, up to $4·00 per acre.

Cutting up trees and burning them, $2·00 to $16·00.

Stumping, $2·00 to $30·00.

First ploughing, $06·0 to $2·00.

Mr. Lamb gives the following as a safe and conservative estimate of the average cost of clearing one acre of land:—

Felling trees	...	$1·00
Cutting and burning	...	4·00
Stumping	...	8·00
Ploughing	...	2·80
Total	...	$15·80

per acre. Under the most favourable conditions the minimum cost is estimated by him at $5·60 per acre.

The above sums represent gross expenditure. In some kinds of forest considerable returns may be expected. In Palawan, for instance, Mr. Lamb states that from 10 to 100 logs of good timber, which will net from $20·00 to $200·00, can ordinarily be had from a hectare of land, so that on such land there may be an actual profit from the timber cut, and the net cost should not exceed $8·00 per acre.

The following information relative to the clearing of forest land was given by Mr. J. H. Shipley, Manager of the Mindanao Estates Company plantation at Davao; one man can clear ·05 of an acre per day of 12 hours, or an acre in 20 days. At $0·25 per day this would make the cost of clearing an acre $5·00.

Mr. Frederick Lewis, formerly in charge of a hemp plantation in Davao, now Lieutenant-Governor of the Sub-province of Bukidnon, estimates the gross cost of clearing forest land at $15·00 per acre.

Governor Monreal of Sorsogon stated that 30 men would clear 250 hectares of land in a year. Estimating the number of working days at 300 and the daily wage at $0·25, this would make the cost of clearing that amount of land $2,250·00, which is equivalent to $3·60 per acre.

Mr. Cadwallader of the Cadwallader Lumber Company states that four men with crosscut saws will fell the timber on a quarter of an acre of heavy forest land in a day. With a daily wage of $0·25 this would make the cost of felling trees $4·00 per acre.

Sr. Vicente Diaz, formerly Governor of the Province of Leyte, makes the following estimate relative to the cost of clearing land: 10 men in 2 days will cut the trees and brush on one acre at a cost of $2·00. After a month one man burns the ground over in one day at a cost of $0·10 per acre. The fire may continue to burn for three or four days. When it has burned out 10 men go in, and while some of them pile the half-burnt wood and clean the land well, others reburn it, at a cost of $1·00, making the total cost $3·10 per acre.

COST OF CLEARING GRASS LAND.

I have experienced much difficulty in getting reliable figures as to the cost of clearing grass land. I have often been assured that it was not necessary really to clear such land before planting coconuts, and that it would suffice to take up the sod in the immediate vicinity of the trees, but a very serious objection to such procedure is found in the fact that trees planted in this way are exposed to risk of total destruction by fire. During the dry season cogon grass is highly inflammable, and coconut trees are very readily injured by heat. Furthermore, my own observation is that for at least three years coconut trees seldom do well when planted in grass land which is not thoroughly ploughed.

Most of the unforested land suitable for coconut planting in the Philippine Islands is covered either with the tall, coarse grass known as cogon, or with a species of bamboo grass which closely resembles sugar cane in appearance, cogon grass being by far the commoner of the two. In order to clean cogon land the grass must first be thoroughly burned off and the land must then be ploughed and harrowed repeatedly so as to get rid of the roots. If this is not done, the cogon will promptly re-establish itself. If native ploughs and harrows are used, the land must be gone over four times the first year and the minimum cost will be $2·00 per acre. It should be gone over twice during the succeeding year at a minimum cost of $1·00. This cost is based on the employment of one native, with two carabaos, a plough and a harrow for each eight acres of land, the native taking the catch crops which he raises as pay for his work, so that the cost is represented by the deterioration of animals and tools.

COST AND VALUE OF CATCH CROPS.

According to Superintendent C. H. Lamb, planting with corn or rice will cost from $0·80 to $2·00 per acre. In Palawan the minimum returns received from an acre of land is 8 bushels of rice, the average maximum is 20, although 30 is not uncommon. The average value of the unhusked rice is $1·25 per bushel, giving an average return from the rice crop of from $10·00 to $25·00 per acre.

According to Mr. Lamb three catch crops may advantageously be grown. He recommends first a crop of corn and subsequently two crops of mountain rice, by which time the coconuts will be too large to permit further advantageous cultivation of rice or corn.

The second and third crops may give a profit, or may only suffice to cover the cost of keeping the land clean and under cultivation, which is necessary in order that the young trees may make their best growth. It is obvious that as the roots of the coconut trees extend, the amount of ground available for cultivation will become less, while the growing tops will throw a constantly increasing amount of shade.

Sr. Vicente Diaz, formerly Governor of the Province of Leyte, estimates that four men will plant rice or corn on two and a half acres of land in a day. The cost of a bushel of seed, which is sufficient, is $1·25, and the total cost of planting is, therefore, $0·90 per acre. This crop is given one cleaning, which takes 10 men one day, at a cost of $2·50. The harvesting of the rice crop takes 10 men one day, at a cost of $2·50. The crop is estimated at 20 bushels, worth $1·00 per bushel or $20·00.

He estimates the crop of corn at 6 bushels of shelled corn per acre. It is usually worth $1·00 per bushel or $6·00 per acre.

According to Mr. C. H. Lamb, the first year's catch crop should yield a profit which should go far toward paying the cost of clearing the land, and the second and third years should yield catch crops which will at least pay for the cost of cultivating the land. During the fourth, fifth and sixth years, by the end of which time the trees will have begun to bear, it will be necessary to keep the land clean, and there will be no returns from catch crops. He states that the cost of such clearing will average $2·00 per acre.

Mr. Frederick Lewis estimates the cost per year of keeping an acre of land clean at $5·00.

Sr. Vicente Diaz estimates that 10 men can clean two and a half acres of ground in one day, at a cost of $1·00 per acre.

In general it may be said that where soil conditions are favourable for catch crops, actual experience has shown that under good management they can be made to pay approximately the cost of the plantation up to the time the coconut trees fruit.

COST OF CLEARING MANGROVE LAND.

Special consideration must be given to mangrove land, as the returns from firewood and tan bark can, according to Mr. C. H. Lamb, invariably be depended upon to pay the cost of clearing and planting. Neither rice nor corn can be grown profitably on this land because of its character. Tapioca, peanuts, and

camotes, or yams, can be grown upon it, but as the soil contains so much salt that ordinary weeds do not spring up within two years after planting, the usual, and probably the best, practice is to depend on coconuts alone rather than to attempt to raise catch crops. It must, however, be remembered that coconut trees planted on this land are not likely to produce so heavily as those planted on more suitable soil, and that they are more likely to be uprooted during severe wind storms, as their roots strike the permanent water-table near the surface of the ground and will not go below it.

Referring in detail to the returns from this land,—one man will ordinarily cut 50 bundles of tan bark in a day. Each bundle is worth $0·10. One man will usually cut one-half cord of wood per day. Deducting the cost of transportation, this firewood will net $4·00 to $5·00 per cord on the Manila market.

Coconuts planted on mangrove land will, it is said, bear invariably before they reach the age of six years, and while such land can hardly be recommended for a coconut plantation, any of it necessarily purchased in connection with other land can be utilized.

COST OF SEED NUTS.

Good seed nuts will cost from one to four cents each. Two and a half cents may be taken as a fair, average cost.

COST OF PLANTING.

The nuts should be sprouted in seed-beds before planting, and the net cost of placing them in the ground, including the cost of care while sprouting, is estimated at from 2½ to 5 cents per nut.

Under such conditions as prevail in the Philippines, nuts should be planted in straight lines 32 feet from each other in both directions. If planted nearer, the tops of the trees will ultimately overlap. This means 40 nuts to the acre, but as a certain percentage of nuts always fails to sprout, and as a certain additional number will make a weak growth at the start, and it is best to plant only very strong growing nuts, 50 nuts to the acre should be allowed. The cost of planting an acre will, therefore, be approximately as follows :—

50 seed nuts at 1 to 4 centavos per nut, $0·50 to $2·00.

Sprouting and planting 40 nuts at from 2½ to 5 cents per nut, $1·00 to $2·00; making a total of $1·50 to $4·00 per acre.

ANNUAL COST OF CULTIVATION AFTER FRUITING BEGINS.

According to a Bureau of Agriculture bulletin on coconut planting, annual ploughing should be continued during the life of the trees. On cogon land two ploughings per year may prove necessary. These ploughings should be relatively shallow but should be sufficient to turn under any green manures such as leguminous crops which may be grown to enrich the soil.

I have seen the value of ploughing quite conclusively demonstrated on the coconut plantation of Sr. San Augustin, near Calapan, Mindoro. This is one of very few coconut plantations in the Philippine Islands where the trees are set out in straight lines and at proper distances. When I last visited this plantation, I noted that the ground had been ploughed between the trees on one side of the highway, while on the other side there had been no ploughing, but the grass had been kept very short by grazing cattle on it. The trees around which the ground had been ploughed looked decidedly more flourishing and were bearing more heavily than were those where it had not been ploughed.

IMPORTANCE OF FERTILIZATION.

Comparatively little attention has thus far been given in the Philippines to the subject of manuring or otherwise fertilizing coconut groves, but enough has been done to show that in this as in other branches of agriculture proper fertilizing pays. The drain on soil fertility for 1,000 nuts, weighing in the aggregate 2,125 pounds, has been found to be as follows: nitrogen, 8¼ pounds; potash, 17 pounds; phosphoric acid, 3 pounds.

Dead leaves should be burned and the ashes scattered on the ground about the trees. Husks and shells should also be burned and the ashes scattered on the ground unless machinery is available for making coir, in which case it might be more profitable to utilize the husks for this purpose and to buy fertilizer as needed. Stable manures, press-cake, and tankage are all valuable. When none of these are available, one may sow and subsequently plough under peas, beans, or other soil-enriching crops.

RATE OF GROWTH AND FRUITING AGE OF COCONUT TREES.

The rate of growth and time before fruiting vary in consonance with the varying conditions of soil and climate. Trees planted near the sea coast in Palawan can be depended upon to fruit before they are six years old. I have seen trees four and one-half years old which were already well loaded with nuts. In many parts of the Islands trees

do not fruit until seven years old. At considerable elevations above the sea fruiting may be delayed for ten or more years, and if one goes high enough the trees cease to fruit at all. It is always difficult to get really reliable information as to the age of young trees. Especial interest, therefore, attaches to the following statement furnished by the Superintendent of the Iwahig Penal Colony, concerning coconuts at various stations of the Iwahig Penal Colony:—

In accordance with instructions received in Memorandum Order Number 2070, the following statement is respectfully submitted:

On October 5, 1910, a thorough inspection was made of the coconut grove at Binuan, situated on a stretch of black sand adjoining the Bay, and only a couple of feet above its level. The seven hundred trees comprising the plantation were set out during the rainy seasons of the years 1907, 1908, and 1909. Rapidity of growth, vigorous health, and freedom from insect attacks is noticeable in this plantation.

The trees planted in 1907 are about twenty-four feet high, six and three-quarters feet in circumference, and have an average of twenty leaves each, springing from the ground up. *One of those trees is now bearing fruit.*

Those planted in 1908 are on an average fifteen feet in height, three and one-half feet in circumference, and bear about ten leaves each.

The one-year-old plants are six feet high and bear about seven leaves each, and are about eighteen inches in circumference at the ground.

A few of the trees are planted in the hummocky crab ground formerly the home of the mangrove. *These, although making fair growth, are not as vigorous as those along the sunny beach,*

On the same date the plantation situated on the Tagculasi promontory was inspected. The five hundred and twenty-two trees here vary in age from *two to six years.* They are entirely free from insect attacks, and the same vigorous healthy growth was observed here as in Binuan.

The soil is mostly of a coral formation, but in some places is gravelly, and in other situations of a loamy character.

Notwithstanding this, there is not much difference in the growth of the trees, *if we except a few growing on the coral soil near the shore, which seem to have made more headway than the others.*

The other trees which were planted thirty feet apart, *bear from 60 to 120 nuts,* but those planted only eighteen feet apart bear fewer nuts and are characterized by long stems.

On October 6th, the plantations of Kabulbug and Santa Tereza were inspected. The older trees were planted in 1907.

They are entirely free from insects, and although making excellent growth, they are not flourishing as well as those at Binuan, *probably on account of being more inland.*

The circumference of the stems of the $3\frac{1}{2}$-year-old trees is about four and one-half feet; height about 15 feet, and they bear about 15 leaves each.

NUMBER OF NUTS PER TREE PER YEAR.

According to a Bureau of Agriculture bulletin, an acre of properly planted coconuts should produce about 2,000 nuts per year, or 50 nuts per tree. The same authority states that trees which by actual count average 50 nuts per tree per year abound; that at Sarabaya trees average 60 nuts per tree per year over hundreds of acres, and that this condition will be found to prevail in Pangasinan, La Laguna, Cebu, Panay, Mindanao, and wherever trees are grown on a generous scale. It is further stated that there are recorded perfectly authentic reports of as many as 128 nuts being taken from a single tree in a year.

One tree at Zamboanga, the owner claims, never produced less than 200 nuts annually, during a period of 23 years. This man claimed that his trees averaged him 100 nuts per year, sometimes falling to 60 and again running as high as 130.

Lieutenant Manuel Fortisch, Philippine Constabulary, reports that at Ginoog, in Misamis, coconuts do particularly well, and that a planter there claims 120 nuts per tree per year from old, well-established trees,

Sr. Vicente Diaz states that mature, bearing coconut trees will produce from 60 to 120 nuts per year, with an average of 80.

Mr. P. J. Moore, who is very familiar with conditions in the Moro Province, states that the actual average annual number of nuts per tree in the District of Zamboanga is approximately 45, This includes large numbers of trees which produce no nuts at all on account of being planted too close together. It would, therefore, seem that an estimate of 60 nuts per tree per year for a grove in which the trees were set at proper

distances and properly cultivated would be conservative.

HARVESTING NUTS.

Nuts when ripe should be carefully harvested. It is best to cut the stems close to the nuts with a sharp knife or a pair of pruning shears. If nuts are not wanted for seed, they may be allowed to fall to the ground, but if intended for planting they must be carefully lowered, as otherwise many of them will be so injured by the fall, that they will fail to germinate. Nuts should be harvested every three months, and at this time dead leaves and the surplus clothlike bark which grows about the bases of the leaves should be removed. If it is found that beetles are boring into the trees to any extent, clean, "sharp" sand should be freely scattered in the axillæ of the leaves, and if any of the large holes made by rhinoceros beetles are found, they should be probed with a hooked wire, the beetles removed and the holes then plugged with wood to prevent them from holding moisture and causing decay.

METHODS AND COST OF COPRA MAKING.

In the majority of cases the method at present employed in making copra is as follows:—The nuts are husked by the use of a sort of metal spear point fixed to a stick set vertically in the ground. The shells are then cracked in halves with well-directed bolo (working knife) strokes, and are placed in the sun, concave side up. A less common though perhaps more advantageous proceeding is to halve the unhusked nuts with a bolo.

As the meats begin to dry they shrink away from the shell and are then readily removed. They may be dried in the sun until all but about 10 per cent. of the moisture has been driven off. If weather conditions are favourable, sun-dried copra is very white and brings a high price, but as coconuts thrive best in regions where the rainfall is quite evenly distributed throughout the year, copra is liable to get wet from time to time when drying, and this darkens it.

Unfortunately, in many districts, the Filipinos do not care to take the trouble to sun-dry their copra, but place it in bamboo racks under which they build fires. Copra cured in this way is not likely to be anything like so uniformly or so thoroughly dried as that cured in the sun. The smoke turns it dark, and the oil obtained from it contains a certain amount of creosote. Any person producing copra on a large scale should install an artificial drying plant.

The system employed for drying codfish at Gloucester, Massachusetts, might well be utilized. A good sized heater causes hot water to circulate through a system of pipes on which are placed "flakes" consisting of rectangular wooden frames over which ordinary poultry wire is spread. These "flakes" are about 10 feet by 6 feet, and are slid in place from both sides of the system of hot water pipes, the whole system being some 20 feet wide. The hot water pipes are contained in a closed chamber in which a number of doors are suitably located. Into this chamber air is forced by a large rotary ventilating fan, and the opening or closing of doors causes it to circulate as desired. Copra dried in this way would be snow white, and would bring a peso or two a picul above the regular market price.

The expense involved would be small, as dried coconut husks make excellent fuel, and the ashes from the furnace would make good fertilizer for the growing trees.

Accurate data as to the cost of harvesting nuts and making copra are not available.

It is stated that the average operator will husk a thousand nuts per day, and that one man has been known to husk as many as 3,000. The work is hard, however, and \$0·50 per day should, therefore, be allowed as the wage for coconut huskers. A second man should be able to halve, and a third to put in the sun the nuts which the first man husks.

I understand that a number of copra making plants in India and Ceylon are now supplied with decorticating, breaking and drying appliances, which make the cost of producing copra materially less than that involved in the use of hand-labour.

ENEMIES OF COCONUTS AND MEANS OF COMBATING THEM.

In the Philippines coconut trees are comparatively free from enemies. In some of the sugar-growing regions the rhinoceros beetle, which breeds in the bagass heaps, sometimes causes considerable losses by boring into the trees, especially if the number of coconut trees is small, so that a large numbers of beetles concentrate their attacks on individual trees. Other species of beetles, which attack the wood of the trees, have been found, but as a rule their depredations are not at all serious. Insects may best be attacked by destroying their breeding places. The spreading of "sharp," coarse, clean sand in the axillæ of the young leaves which are favourite points

of attack is said to be useful. Probing with a stout, hooked wire may be effective in case of the rhinoceros beetle.

After all is said and done, clean cultivation is the great remedy for insect pests which are not at all likely to cause serious damage on well-kept plantations.

On the mainland of the larger Islands monkeys, crows and fruit bats cause a certain amount of damage by destroying young nuts. Judicious use of a shot-gun will reduce to an unimportant minimum the losses from such sources.

Wild hogs are the coconut planter's most serious enemy. On the islands where they abound nothing will suffice but careful fencing until the trees are at least two years old, after which time they are not liable to injury by hogs.

Bud-rot, which causes heavy losses in some coconut-growing countries, is almost unknown in the Philippines. So far as I am aware, it has developed in only one small area in Laguna province. Here it was vigorously attacked and promptly stamped out.

PROFITS.

With reference to this subject, Supt. C. H. Lamb, of the Iwahig Penal Colony, makes the following statement :—

The conclusion reached, from the writer's experience, is that coconut planting for a permanent crop and investment, cannot be equalled by any other known permanent crop, not even rubber. It is superior to rubber in the Island of Palawan. The usual argument advanced to the contrary, places great value upon the fact that Palawan does not have typhoons which would damage the rubber crop—the same fact is of almost equal value to the coconut. The thing which caused the writer to begin the coconut industry before he had data available which would show the cost of planting, was the short time in which the trees reach maturity and begin to bear.

Sr. Vicente Diaz states that 240 nuts, more or less, will make a picul (137½ lbs.) of copra.

Sr. Palanca of Binuan, Busuanga, gets a picul of copra from 160 to 180 nuts.

Mr. P. J. Moore states that in the District of Zamboanga 180 to 220 nuts make a picul of copra.

The Bureau of Agriculture Bulletin estimates 2,000 nuts per acre. They should produce copra to the value of at least $50·00.

Mr. J. H. Shipley of the Mindanao Estates Company plantation states that at Davao the average value of the crop of a coconut tree is $1·00 per year. This would give gross returns of $40 per acre.

One picul of copra from 200 nuts should be a conservative average on a well-kept plantation, and allowing 60 nuts to the tree and 40 trees to the acre, this would give 12 piculs per year, which at $5·00 per picul would give gross returns of $60·00 per acre per year, from which must be deducted the annual cost of cultivating between the trees, say $5·00 per acre, and the small cost of harvesting the nuts and making the copra. As coconut trees attain great age and have been known to produce when a hundred or more years old, it is evident that a plantation, once well established, should give steady and large profits for a long period of years.

Hon. Manuel Quezon, a native of the Province of Tayabas, who is thoroughly familiar with the coconut industry there, states that the maximum annual *profit* from a bearing coconut tree is $1·50, and the minimum annual *profit* is $1. This estimate is for fire-dried and smoked copra, which is an inferior article, and based on giving one-half of the copra from each tree to the man in charge. One individual can care for 1,000 trees, and in order to get his half of the copra he must do this throughout the year, cleaning the brush from the ground, removing dead leaves, etc., harvesting the nuts every three months, and drying the copra.

During the past year the best sun-dried copra has brought as high as $6·00, and even $7·00 per picul, and the price of copra has held very steady for years, with a slight tendency upward.

ESTIMATED COST OF ESTABLISHING A 2,500 ACRE COCONUT PLANTATION ON RENTED PUBLIC LAND.

The following is a statement of the approximate cost of establishing a 2,500-acre coconut plantation and of the revenues which should be derived therefrom at practically the existing market price of copra. It should be remembered, however, that properly dried copra will unquestionably bring a price materially in advance of that commanded by the smoked and imperfectly-dried article which at present makes up the bulk of the Philippine product.

This estimate is based on clearing half of the land the first year and half the second year. 200 acres of land are reserved for buildings and other purposes. A more liberal allowance is

made for the cost of clearing the land and preparing it for planting than is called for by the estimates hereinbefore quoted, and as the returns from catch crops will manifestly depend directly on the character of the soil selected and on the efficiency of the administration of the estate, no allowance is made for them.

Practical experience has shown that under capable administration, with favourable soil and market conditions, they may be made to pay the cost of clearing and planting the land, and that of keeping it clean during the first two or three years after it is cleared. I am of the opinion that if this is done it is all that can be expected, and I doubt somewhat whether it would be feasible to achieve this result on a coral island. Nevertheless, if I myself were selecting a site for a coconut plantation, I should select one on a coral island which was pretty well isolated in order to avoid possible danger of insect and other pests, which might result from the fact that neighboring plantations, if any existed, were badly cared for.

FIRST YEAR.

	On Ordinary Forest Land.	On a Coral Island.
Survey ...	$ 250·00	$ 75·00
Rental ...	256·00	256·00
Clearing and ploughing 1,250 acres at $20 per acre	25,000·00	...
Clearing 1,250 acres at $10 per acre (ploughing not necessary) ...	...	12,500·00
Cost of seed ...	1,656·25	1,656·25
Planting 33,000 nuts, at $02½ each ...	825·00	825·00
Fencing ...	1,000·00	...
Assistant manager's salary	1,800·00	1,800·00
Assistant manager's house	1,000,00	1,000·00
Labourer's quarters ...	2,000,00	2,000,00
Storehouse for rice, tools, trade-goods, etc. ...	500·00	500·00
Well, tank, pumping engine and pipe for water supply ...	600,00	600·00
1 mile of track (rail, 12 lbs. to yd.) ...	765·00	765·00
5 cars at $30 each ...	150·00	150·00
Tools ...	500·00	500·00
15 draft cattle, at $40 per head ...	600·00	600·00
One American or Australian horse ...	150·00	150·00
Two native ponies, at $50 each ...	100·00	100·00
One 30-foot launch, with 10 h.p. petroleum engine ...	1,500·00	1,500·00
Launch engineer at $37·50 per month ...	450·00	450·00
Kerosene, engine oil, cotton waste, for launch ...	200·00	200·00
Totals ...	$39,302·25	$25,627·25

NOTE.—A launch is estimated for, because unless the plantation is located directly on some inter-island harbour, one will be necessary in keeping up communication between the plantation and the nearest port. A liberal estimate has been made for quarters for men, which would allow of putting up a substantial shed, with galvanizhd iron roof. It would give the men good quarters, and could later, at small additional expense, be converted into a drying shed, while the iron roof would be useful for catching rain water, especially on coral islands. A good well, with a pump, tank and pipe is essential in order to provide adequate bathing facilities for the assistant manager and men, and water for animals, sprouting nuts, etc.

It would probably be necessary to run a small store in connection with a plantation at which articles of common necessity should be sold at Manila prices, plus 20 per cent. plus cost of transportation, but labour should be paid for in cash and the men left free to trade at the store or not, as they please.

From the total should be deducted the receipts from catch crops, if any, and from the sale of timber and firewood, which on forest land might somewhere nearly cover the cost of clearing and planting. The sandy soil of coral islands will grow pineapples, peanuts, cassava, corn, or yams, but as weeds do not spring up readily on this soil, and as comparatively little work is required to keep it clean, it might be more desirable not to plant catch crops but to leave all plant food in the soil for the coconut trees.

It will be noted that I have provided for an assistant manager only. It would be necessary to have one competent man constantly on the ground. There would be necessity for work in other places in connection with the purchase and shipment of supplies, seed nuts, etc., and the securing of labourers, which should be performed by a manager, and the best way to provide for this unless the owner himself cared to do it, would be to have one thoroughly competent man who would serve as general manager for several plantations, and who would not only perform the work above referred to, but would visit and inspect the plantations at frequent intervals.

If the assistant manager proves capable, his salary should be raised $2,000·00 per year until it reaches at least $3,000·00.

SECOND YEAR.

	On Ordinary Forest Land.	On a Coral Island.
Rental ...	$ 256	$ 256
Clearing and ploughing acres at $20 per acre 1,250	25,000	...
Clearing 1,250 acres at $10 per acre (ploughing not necessary) ...	...	12,500
Cleaning 1,250 acres of land already planted at $10 per acre ...	12,500	...
Cleaning 1,250 acres of land already planted at $5 per acre ...	...	6,250
Planting 33,000 nuts at $02½ each ..	825	825
Fencing ...	1,000	...
40 labourer's houses at $25 each ...	1,000	1,000
Assistant manager's salary	2,000	2,000
Tools ...	400	400
5 draft cattle at $40 per head ...	200	200
Launch engineer at $37·50 per month ...	450	450
Kerosene, engine oil, cotton waste for launch	200	200
Depreciation on buildings, track and water system (10 %) ...	451·50	451·50
Depreciation on launch (20 %) ...	300	300
Totals ...	$44,582·50	$24,832·50

NOTE.—From the totals above given should be deducted the receipts from the sale of catch crops and from the sale of timber and firewood, if any.

THIRD YEAR.

	On Ordinary Forest Land.	On a Coral Island.
Rental ...	$ 256	$ 256
Cleaning 2,500 acres of land at $5 per acre ...	12,500	...
Cleaning 2,500 acres of land at $2,50 per acre ...	...	6,250
Assistant manager's salary	2,200	2,200
Tools ...	250	250
5 draft cattle at $40 per head ...	200	200
Launch engineer at $37·50 per month ...	450	450
Kerosene, engine oil, cotton waste, for launch	200	200
Depreciation on buildings, track and water system	451·50	451·50
Depreciation on launch (20 per cent.) ...	300	300
Totals ...	$16,807,50	$10,557·50

NOTE.—From the total should be deducted the value of catch crops, which on forest land should be sufficient to pay the cost of keeping the land clean.

FOURTH YEAR.

	On Ordinary Forest Land.	On a Coral Island.
Rental ...	$ 256	$ 256
Cleaning 2,500 acres at $5 per acre ...	12,500	...
Cleaning 2,500 acres at $2·50 per acre ...	...	6,250
Assistant manager's salary	2,400	2,400
Tools ...	200	200
5 draft cattle at $40 per head ...	200	200
Launch engineer at $37·50 per month ...	450	450
Kerosene, engine oil, cotton waste, for launch	200	200
Depreciation on buildings, track and water system (10 per cent.) ...	451·50	451·50
Depreciation on launch (20 per cent.) ...	300	300
Totals ..	$16,957·50	$10,707·50

NOTE.—From this year on there will be no catch crops of importance.

FIFTH YEAR.

	On Ordinary Forest Land.	On a Coral Island.
Rental ...	$ 256	$ 256
Cleaning 2,500 acres at $5 per acre ...	12,500	...
Cleaning 2,500 acres at $2·50 per acre ...	...	6,250
Assistant manager's salary	2,600	2,600
Tools ...	200	200
5 draft cattle at $40 per head ...	200	200
Launch engineer at $37·50 per month ...	450	450
Kerosene, engine oil, cotton waste, for launch	200	200
4 miles of track ...	3,100	3,100
½ mile of portable track ...	1,380	1,380
10 cars at $30 each ...	300	300
Depreciation on buildings, 1 mile of track, and water system (10 %) ...	451·50	451·50
Depreciation on launch (20 per cent.) ...	300	300
Totals ..	$21,937·50	$15,687·50

NOTE.—On favourable land some nuts will be harvested during the fifth year.

SIXTH YEAR.

	On Ordinary Forest Land.	On a Coral Island.
Rental ...	$ 256	$ 256
Cleaning 2,500 acres at $5 per acre ...	12,500	...
Cleaning 2,500 acres at $2·50 per acre ...	...	6,250
Assistant manager's salary	2,800	2,800
Tools ...	200	200
5 draft cattle at $40 per head ...	200	200
Launch engineer at $37·50 per month ...	450	450
Kerosene, engine oil, cotton waste, for launch	200	200
Depreciation on buildings, track and water system (10 per cent.) ...	929·50	929·50
Depreciation on launch (20 per cent.) ...	300	300
Totals ...	$17,83·50	$11,585,50

NOTE.—The sixth year a half crop of 30 nuts per tree may be estimated. While all the land in the plantation will need to be cleared in the first instance and kept clean thereafter, it will be safe to allow 200 acres for waste land and for that used for buildings, etc., so the crop of nuts for sixth year from 1,150 acres may be estimated at 1,380,000, which should give 6,900 piculs of copra, worth $34,500, less cost of harvesting nuts and making copra.

SEVENTH YEAR.

	On Ordinary Forest Land.	On a Coral Island.
Rental ...	$ 256	$ 256
Cleaning 2,500 acres at $5 per acre ...	12,500	...
Cleaning 2,500 acres at $2·50 per acre ...	...	6,250
Assistant manager's salary	3,000	3,000
Tools ...	200	200
5 draft cattle at $40 per head ...	200	200
Launch engineer at $37·50 per month ...	450	450
Kerosene, engine oil, cotton waste, for launch	200	200
Depreciation on buildings, track and water system (10 per cent.) ...	929·50	929·50
Depreciation on launch (20 per cent.) ...	300	300
Totals ...	$18,035,50	$11,785·50

NOTE.—This year a full crop of 2,750,000 nuts may be estimated for 1,150 acres and a half crop of 1,380,000 nuts from the remaining 1,150 acres under cultivation, or 4,140,000 nuts in all, from which 20,700 piculs of copra should be obtained, worth $103,500.

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EIGHTH YEAR.

	On Ordinary Forest Land.	On a Coral Island.
Rental ...	$ 256	$ 256
Cleaning 2,500 acres at $5 per acre ...	12,500	...
Cleaning 2,500 acres at $2 50 per acre ...	...	6,250
Assistant manager's salary	3,000	3,000
Tools ...	200	200
5 draft cattle at $40 per head ...	200	200
Launch engineer at $37·50 per month ...	450	450
Kerosene, engine oil, cotton waste, for launch	200	200
Depreciation on buildings, track and water system (10 per cent.) ...	929·50	929·50
Depreciation on launch (20 per cent.) ...	300	300
Totals ...	$18,035·50	$11,785·50

NOTE.—During this year and thereafter a full crop of nuts should be harvested from the entire 2,300 acres, amounting to 5,520,000 nuts, equivalent to 27,600 piculs of copra, worth $138,000.

CONCLUSION.

It will be noted that the foregoing estimate is based on clearing half of the ground the first year and half the second. If labourers and funds are available, it would obviously be more advantageous to clear the entire tract the first year, as the period when the first full crop could be anticipated would thus be advanced by one year. On the other hand, if sufficient capital is not available at the outset to clear so large a tract as the one indicated, a smaller tract of any desired size may be cleared. As the charge for rental of the land is small, there is no considerable pecuniary loss involved in clearing the land quite slowly.

That the above estimate as to the returns which may be anticipated is conservative, is shown by the statement of Hon. Manuel Quezon as to the actual returns obtained in the Province of Tayabas under existing unsatisfactory conditions as to planting and care of trees. He receives half of the price of the copra in return for giving the ground such cleaning as it receives, looking after the trees, harvesting the nuts, and making the copra. The *net profit* to the owner under this arrangement is from $1 to $1·50 per tree, an average of $1·25. On this basis 92,000 trees would give an annual net profit of from $92,000 to $138,000, or an average net profit of $115,000, and it would indeed be remarkable if trees properly set out and cared for in a region well to

the south of Tayabas and not subject to the violent wind storms which not infrequently sweep across that province, did not do better than this.

It will also be noted that I have not allowed for any returns except from copra. It goes without saying that it would be advantageous to instal a coconut oil mill as soon as the output of nuts in any given region was sufficient to justify it. What appears to be a reasonably conservative estimate of the profits from a coconut oil plant with a capacity of 1,000 piculs a day, running at its full capacity 300 days in the year, shows them to be approximately 120,000 dollars per year. It would take the copra from eleven 2,500-acre plantations to keep such a mill running, but the estimate above referred to is based on the purchase of copra in the open market, and whatever copra was required in excess of that produced on the plantation or plantations of those interested in the mill could be obtained in this way. In fact, a mill might at any time be established at Manila or some other port of entry and be operated at a profit prior to the time when the plantations became productive, so that advantage could be taken of its facilities from the moment nuts were produced.

Actual experience has shown that there is a material loss of the oil in copra during its shipment from the Philippine Islands to the United States or to European ports, this loss being due in large measure to the fact that the mould which grows on copra thus shipped decomposes the oil,

A food product resembling butter, and used as a substitute for it, is now manufactured in large quantities from coconut oil. An important source of increased revenues might unquestionably be found in the manufacture of this product, and of soap, candles, and shredded coconut.

Both coconut oil and all other coconut products from the Philippine Islands are, under existing tariff regulations, admitted to the United States free of charge, which would place a factory manufacturing them at a decided advantage over similar factories in other countries so far as concerns the United States market, which is very important.

Figures as to the cost of a coconut oil plant of the capacity above mentioned, and as to the profits which may be anticipated therefrom, will be furnished upon application.

DEAN C. WORCESTER.

THE SOY BEAN.

BY VICTOR DESCHAMP,
Analyst, Agricultural Laboratory.

(From the *Journal of the Department of Agriculture of Victoria*, Vol. IX., Part 9, September, 1911.)

Despite the favourable reports published in numerous scientific and trade publications throughout the world, the cultivation of the Soy Bean has not yet been seriously undertaken in Victoria. Although it is unlikely that the bean can be grown in this State cheaply enough to compete with the Chinese product, principally on account of the difference in the cost in labour, it should be a remunerative crop. As a fodder crop, as a soil renewer, and as a green manure, it has been successfully grown in countries other than its native habitat and under varying climatic conditions, As there are over 300 known varieties and hybrids, some of these should be suitable for different parts of this State.

ECONOMIC USES.

The home of the Soy Bean is in Manchuria and Japan, and it has been grown there in large quantities for centuries, but until a few years ago no attempt was made to grow it elsewhere on a commercial scale. In the countries named a small part of the oil, 6 to 8 per cent. only, was extracted by primitive presses, and the residual oil cake used as a fertilizer. The Imports of cake to Japan in 1905 were 182,000 tons, while in 1909 the enormous amount of 600,000 tons was exported to Japan alone, showing that its use as a fertilizer is greatly on the increase, in spite of competition with artificial fertilizers. The estimated total crop in Manchuria for 1909 was over 1,500,000 tons of shelled beans.

The first large cargo of soy beans consigned to England arrived in Hull in March, 1909, and amounted to 5,200 tons, and before July of the same year, contracts had been made for the delivery of no less than 200,000 tons, to be utilized for oil extraction and the residual cake for cattle food. According to the London "Times" of 19th July, 1910, the requirements of the following season in England were estimated at over one million tons. At the minimum price of £6 10s. per ton, this means a business of £6,500,000, but it is doubtful if the beans can be bought under about £8 per ton, owing to shortage of supply. That an industry of such vast proportions should spring up in a few years ndicates that all the opportunities of

commerce are not closed to those who have foresight enough to search for new openings for trade.

Food for Human Consumption.—The beans form an important article of diet for the Chinese and Japanese, being used in some form or other at almost every meal, and by all classes of people. They are highly nutritious, containing a large amount of edible oil (15 to 20 per cent. of the seed); they are also very rich in proteids and bone-forming mineral matter-phosphates; potash and lime are present in large amounts. The most abundant salt in the ash is sodium phosphate. The protein is present in amounts varying from 30 to 42 per cent. of the bean, and is remarkable in that it consists mainly of albumenoids that resemble milk casein in composition and digestibility; in this respect it differs from any other known bean.

Soy bean milk and sauce preparations, and also the oil, are very nutritious articles of diet.

A medical point of view is given in the *Lancet* of 21st January last:—

On account of the great nutritive value of the Soy Bean, it is well worth medical attention, more particularly for diabetic cases, because of its low proportion of starch. For making biscuits, soup powder, infant and other foods, it will be widely used in future when its dietetic value becomes better known.

Stock Food (Beans and Cake).—"In England, the bean cake is of even more importance than the oil, representing as it does about 80 per cent. of the raw material. The analysis compares very favourably with best cotton seed cake meal. In 1909, the bean cake was sold at £6 12s. 6d. per ton in London, while cotton seed cake costs £7 10s. to £7 12s. 6d."—*Economist.*

Denmark in 1910 sent large orders to Manchuria as the result of the success attained by feeding the soy cake to cows. With regard to its effect on butter, experiments made at the Cirencester Royal Agricultural College, England, show that no particular flavour was detected as a result of feeding soy cake; and that, compared with cotton cake, the yield of butter was slightly more, and no difference was perceived in laxative effects. On feeding the beans themselves to cows, the butter produced was a trifle soft, but not enough to injure its commercial value, the softness being due probably to the large amount of oil contained in the bean.

From 3 to 4 lbs. of soy beans per day added to the usual dairy ration of hay fodder maize is stated to increase the winter milk yield of the average Kansas cow over 25 per cent. In a series of experiments with pigs in Kansas,—"It was shown that when soy beans are fed with maize, grain, and Kaffir corn for fattening pigs, a saving was made in the amount of feed needed to make 100 lbs. of grain of 13, 24, 31, 33, and 37 per cent., the amount varying in different experiments."

Green Fodder.—Upwards of 13½ tons of green fodder were obtained per acre at Cheltenham, and 10 tons per acre at Ballarat. These are the only two instances in Victoria where records of tonnage per acre were kept. Cows will readily eat this plant after they become accustomed to the taste.

For green feed, cut when near the full bloom, as at this period the amont of nutrients is much higher than when cut at other stages of growth. When wanted for hay, cut when the pods are about half filled and dry; handle the same as pea hay.

No instance of its use in this State as silage is noted, but in the United States it is often ensiled with green maize, making an excellent succulent food, and being an almost balanced ration.

Rotation Crop.—In the United States it has been found that the yields of crops of all kinds is increased where they follow soy beans, wheat in large fields showing an increase of 5 bushels per acre over that grown on land alongside that which had not been under beans. Wheat generally follows a nitrogenous crop in the usual rotation schemes on the continent.

Fertilizer.—The conclusions arrived at after hundreds of experiments in other countries is that, if there are no tubercles on the roots, the growing bean does not add fertility to the soil, but simply makes available for other crops the plant food already in the soil. When the plants are inoculated with tubercles, undoubted increase of fertility will result in the form of available nitrogen to the soil.

The large quantities of Soy bean cake exported to Japan for use as a fertilizer (600,000 tons in 1909), without any mention being made of Japan's own quota, speaks for itself, and this in spite of competition with artificial manures. The Japanese recognize the value of organic manures.

Australians do not attach enough importance to the value of humus as an element of fertility. There is a

marked deficiency of this substance over practically the whole of our continent, and this is due to the character of the vegetation. Our trees are evergreen, and consequently do not shed their leaves. In most other countries the deciduous trees predominate, and a large amount of organic matter in the shape of fallen leaves is added to the soil year by year. This becomes decomposed into what is called humus, principally by bacterial action, and this substance becomes one of the great sources of nitrogen for the food of plants. A soil well supplied with humus is generally regarded as fertile. Another great value of organic matter and its resulting humus is its capacity for holding moisture and keeping the soil open in texture. This is why farmyard manure is so appreciated in this country. Soy bean cake, if it can be bought cheaply enough, would be a splendid organic manure for our lands, especially as it also contains a very high percentage of nitrogen phosphate and potash.

Green Manure.—The remarks under the previous heading apply also to the use of the plant as a green-manure.

ANALYSIS OF GREEN SOY BEAN PLANTS.

CONSTITUENTS.	VARIETIES GROWN AT CHELTENHAM EXPERIMENTAL FARM (CUT WHEN SEEDS WERE FORMING IN THE PODS.)								HEIDELBERG (MATURED PLANT, PODS REMOVED).	
	Ito San.		Guelph.		Baird.		Brownie.		Variety not known.	
	Sample as Received.	Dry.	Sample as Received.	Dry.	Sample as Received.	Dry.	Sample as Received.	Dry.	Sample as Received.	Dry.
Moisture	59·70	...	61·20	...	60·10	...	60·80	...	58·0	...
Ash	4·02	9·98	3·96	10·21	4·34	10·85	4 36	11·12	6·43	15·30
Protoin (N × 6·25)	7·90	19·60	7·54	19·43	6·74	16·85	6 62	16·89	8·20	19·53
Crude Fibre (Pentosan free) ...	5·89	16·62	7·59	19·56	7·55	18 88	5·93	15·13	5·22	12·43
Nitrogen Free Extract ...	21·26	52·75	18·35	47·29	20·11	50·27	21·19	54·05	21·27	50·65
Ether Extract ...	1·23	3·05	1·36	3·51	1·26	3·15	1·10	2·81	0·88	2·09
Digestible Nutrients.		Albumenoid Ratio, 1 : 3·59.		Albumenoid Ratio, 1 : 3·52.		Albumenoid Ratio, 1 : 4·19.		Albumenoid Ratio, 1 : 4·24.		Albumenoid Ratio, 1 : 3·33.
Digestible Dry Matter ...	24·98		24·06		24·80		24·30		26·04	
,, Protoin ...	5·45		5·20		4·65		4·57		5·66	
,, Fibre ...	2·41		3·11		3·10		2·43		2·14	
,, Nitrogen Free Extract	15·52		13·40		14·68		15·47		15·53	
,, Ether Extract ...	0 66		0·73		0·68		0·59		0·48	
	Sample 2 feet 9 inches in height.		Main Shoot, 5 feet long.		Main Shoot 4 feet long.		Sample, 3 feet long.		Sample, 2 feet long.	

VARIETIES.

There are nearly 300 varieties catalogued in Bulletin No. 197—"*The Soy Bean: History, Varieties and Field Studies*, 1910." Published by the United States Department of Agriculture. The periods of maturity vary from 80 to over 150 days.

Very early ...	80 to 90	days.
Early ...	90 ,, 100	,,
Medium early ...	100 ,, 110	,,
Medium ...	110 ,, 120	,,
Medium late ...	120 ,, 130	,,
Late ...	130 ,, 150	,,
Very late ...	more than 150	,,

The best varieties mentioned in the Bulletin referred to are :—

Very early.—Ogemaw No. 17,258

Early.—*Early* Brown 25,161, *Vireo* 22,874, Wisconsin Black 25,468.

Medium early.—Chernie 18,227, Auburn 21,079, Elton 20,406.

Medium.—Ito San 17,268, Medium Yellow 17,269, Swan 22,379, Brindle 20,407.

Medium late.—Brooks 16,789, Austin 17,263, Peking 17,852B, Flava 16,789A, Cloud 16,790, Haberlandt 17,271.

Late.—Mammoth 17,280, Hollybrook 17,278, Tokyo 17,264, Farnhan 22,312, Flat King 17,252, Acme 14,954.

Very late.—Harchet 20,798, Riceland 20,797.

CULTIVATION.

In a general way, any soil that will grow maize will grow soy beans, providing that the soil is not acid in reaction; a soil of medium texture containing lime, potash, phosphoric acid in fair amounts is the most suitable. Good results were obtained on the sandy soil of Cheltenham and on the rather stiff clay hill soil at Lilydale, the potash of the clay being first made available by winter dressing with lime before sowing. If potash and phosphate are lacking, they should be supplied in the form of artificial manure. Nitrogenous manures are not necessary, except in the case of poor or sandy soils to give the young plants a start. The plant is said to be drought resistant, and to be able to endure slight frosts.

Experiences is this State show that if too much rain falls after sowing the seed, and before the plant has had time to thoroughly establish itself, the results are disastrous. The young plants seem to withstand dry weather better than young French beans of the same stage of growth, and their capabilities of withstanding our hot north winds are about the same. No advantage was gained by soaking the seed before sowing the germination taking from 10 to 25 days. On stiff soil, I found that the imported seed, giving only 10 per cent. germination by the ordinary sowing, 1 in. deep, gave a 90 per cent. germination when shallow 1-in. drills were opened up and the seeds covered with decomposed organic matter (grass) using no soil whatever to cover them.

Do not sow until the ground becomes warm and all danger of frost is over. No extra growth is got by too early sowing; the weeds will be harder to keep down, and more cultivation will be necessary. Better results are obtained from drilling than broadcasting. The seeds should be sown thickly enough in the row to give a plant every 4 in. to 6 in., the rows to be 30 in. to 42 in. apart. About half a bushel of seed per acre will be sufficient. In preparing the ground, the soil should be well tilled. After sowing the land must be kept fairly free from weeds, and the surface soil occasionally stirred, but this should not be done when the young plants are wet from dew or rain. The cultivation should be frequent enough to keep the surface soil loose until the beans begin to bloom.

Inoculation of the Seed.—On new land it is advisable, if possible, to inoculate the seed with soil from an old soy bean field. Plants that become inoculated with tubercles give a much better crop of beans than those that are not inoculated. In the United States a number of different methods for inoculation were tried, and the only satisfactory one was found to be placing the infected soil in direct contact with the beans. If the infected soil is sown broadcast or ploughed in, the results obtained are never satisfactory; 200 lbs. or 300 lbs. of infected soil will be sufficient for one acre, and it is probable that a field once inoculated will always remain inoculated.

HARVESTING SEED.

The flowers are either purple or white according to variety and are completely self fertile; bagged plants set pods as perfectly as those in the open. The abundant pollen of each flower covers the stigma almost as soon as the flower opens. In nearly all varieties the leaves turn yellow as the pods ripen, and most have fallen by the time the pods are mature. On this account it is difficult to cut the crop for grain and save the foliage as well. A very few varieties retain their leaves, an example being the "Wisconsin Black." The pods are in clusters up to five or more, and a single plant may bear 400 pods, but the most I have seen is fifty-two.

There is a continuous succession of varieties from early to very late. With very few exceptions earliness is correlated with size, the largest varieties being latest. As with the cow pea, early sowing takes a longer time to mature than late sowing. In general, the later the variety, the more is its life period shortened by later sowing. As a general rule, the soy bean, when wanted for seed, should be cut when the majority of the pods are getting brown in colour and about half the leaves have fallen. Some varieties shed their seed very easily when about ripe, and it is advisable to cut and rake at a time of day when the pods are slightly moist with dew. Rake immediately into small stooks.

In America, portable frames are used and the cut plants heaped in them, thus insuring a good circulation of air to produce good curing. If the crop is cut and bound, the sheaves are apt to become mouldy. When dry the seed can be readily separated by means of an ordinary threshing machine.

Soy beans for seed must be kept in thin layers in cool, well ventilated bins. When buying seed, empty the bags as soon as received, and keep the beans spread out in a cool dry place. The best

of seed, if kept in bags till sowing time, may heat sufficiently to destroy its growing powers.

EXPERIMENTS IN VICTORIA.

In 1909 a quantity of seed was imported from America. The variety was not known. In some districts, plants from this seed grew very well, notably at Lilydale on clay soil, making a uniform growth of 48 in. and having a strong upright stem. It was evidently a good variety for hay, but bore only a medium crop of beans. The ripe pods did not burst easily, and stood exposure in the field. At Heidelberg, this variety had only medium success. The germination was low, owing to heavy rain rotting the seed which was soaked before sowing. The unsoaked seed also suffered from the prolonged rains and the plants never properly recovered. The seed was sown on 4th October and required twenty days to appear above ground. The pods ripen unevenly and were not ready to harvest until 1st May, the resulting seed being much smaller than the original. No tubercles were found on the roots. At Caulfield, in sandy soil, the seed germinated well. but the plants were eventually ploughed in as green manure.

In September, 1910, a consignment was received by the Department of Agriculture from Shanghai, through Mr. J. M. Sinclair, Commercial Agent for Victoria in the East. From this consignment of one variety a number of seeds differing from the bulk in shape or colour were handpicked. These were grown separately at Cheltenham. They were sown on 10th October, and were cut for green fodder on 27th February. The following yields were obtained :—

Variety.		Yield per acre.		
		Tons.	Cwts.	lbs.
Ito San (Yellow)	...	12	8	54
Baird (brown)	...	13	10	10
Brownie (brown)	...	11	6	98
Guelph (green)	...	11	6	98

By the accompanying illustrations* it will be seen that some varieties grow luxuriantly at Cheltenham. The soil is very sandy with a clay subsoil. The seeds were sown in drills 3½ feet apart on the 10th October, and 98 per cent. of the seeds of the varieties mentioned germinated in ten days. The land was kept clean for the first two months by inter-tillage. When photographed, the plants were from 3 to 5 ft. in height, with abundance of pods and leaves.

Experiments were also conducted at Ballarat, Bellarine, Heidelberg, Lilydale and other centres throughout the State. Although a moderate amount of success was achieved further experiment will be necessary. With that object in view the Department of Agriculture has recently imported a large quantity of seed for distribution.

* Not reproduced.

PROBABLE CAUSES OF FAILURE.

Every new plant has its peculiarities, its likes and dislikes as to soil, depth of sowing, and susceptibility to climatic conditions, so these may vary from each particular variety of soy bean. Until we can find out what varieties are best suited to those varying conditions we must not condemn this bean. Other countries, for instance, the United States, underwent similar experiences, and for a long time the soy bean was much decried. Some of the likely causes of failures in Victoria will now be dealt with.

(1.) *Bad Germination.*—It has been proved that seeds rich in both oil and proteids are very susceptible of having their germinative powers destroyed by sweating and heating. As the seeds had naturally to be imported, the result was often a very poor stand or none at all. I have proved this for the last three years, the acclimatized and fresh seeds in every case giving a germination of 95 to 100 per cent. Seed more than one year old, and imported seed that has sweated in transit, are primarily the cause of bad germination. Until there is a sufficiency of locally grown seed to distribute to the farmers discouraging reports as to germination results will continue to be received.

(2.) *Variety.*—So far there has been no choice of variety. Some varieties are totally unsuited for this State, although succeeding elsewhere, notably the Buckshot and Mammoth. The former was found to be the hardiest for North Queensland and with opposite results in this State.

(3.) *Alkalinity of the Soil.*—It must be borne in mind that many of the leguminous plants depend for their successful growth on the presence of the right kind of bacteria in the soil, and on new soil there is often considerable difficulty in getting the soy plant inoculated with tubercles of nitrifying bacteria. By growing this bean for three or four years in succession on the same soil inoculation is almost sure to result, provided the soil is not acid in reaction. My opinion is that the nitrifying bacteria necessary for the good growth of any papillionaceous plants are all essentially of the same race, with this

qualification, that they will take more or less time to adapt themselves to the new kind of legume.

If inoculated soil from an old soy bean field is not sown with the beans on new land, and the proper bacteria are not present already in the soil, it is necessary to have a fair amount of available nitrogen present to grow the plant. Numerous experiments in other countries show that on soils poor in nitrogen, the soy beans, without nodules on their roots, make unsatisfactory growth. It is also recognized that any of the leguminous plants will not thrive on an acid soil, mainly because the bacteria are not in that case able to develop and thrive; therefore the importance of the addition of lime to those lands to make them alkaline, and also of the secondary effect that the lime has of liberating potash from clays, which is so necessary for the growth of legumes.

(4.) *Depth of Sowing the Seed.*—This is another prolific cause of failure. For our climate, the depth of sowing should be as shallow as the moisture supply will permit. There is less chance of failure through the formation of a soil crust. Near Melbourne, I have found that on stiff soils it is sufficient to just cover the seed; 1 to 2 in. would be about the right depth for the warmer parts of Victoria.

Other Causes of Failure may be due to continued heavy rain falling and rotting the seed, or injuring the young tender plants before they are sufficiently developed. Hot north winds are also dangerous. Rabbits, slugs and cut worms are very partial to the young plants.

FRUITS WORTH GROWING IN CEYLON.

BY H. F. MACMILLAN, F.L.S., F.R.H.S.

The following paper was read by Mr. H. F. Macmillan at the meeting of the Ceylon Board of Agriculture on Monday noon, October 16th, 1911:—

Having received but very short notice, I fear I can only give you a few cursory notes on fruits worth growing in Ceylon. The subject is a familiar one, but is nevertheless of much importance to most people in this island, and therefore perhaps no apology for bringing it before you once more is necessary. Out of the large number of tropical fruits known to us, there are obviously several that are worth growing in Ceylon. Equally certain, however, is the fact that many of the fruits grown are not worth eating.

A remarkable feature of tropical fruits in general is their extraordinary dissimilarity, and, consequently, the great diversity of tastes that exists regarding them. Some have been described as

"EDIBLE, BUT NOT WORTH EATING;"

whilst with others an acquired taste is necessary in order to properly enjoy them. Others again are eaten rather as a matter of sentiment, than on account of any seductive flavour, as for example the Papaw and the Grape-fruit. A few, on the other hand, have the peculiarity of possessing extremely attractive qualities to some people, while to others they are emphatically things to be avoided. The durian fruit might be given as an example of the latter, for in spite of Professor Russell Wallace's opinion that "the experience of eating durians is worth a visit to the East," equally strong statements to the contrary have been made by the other side. Pomegranates are eagerly bought by some people at as much as 50 cents each, but the description of "shot steeped in vinegar" seems to me more or less appropriate to this fruit as grown in Ceylon.

So pronounced is the diversity of tastes for tropical fruits in general, that even such excellent kinds as the Avocado-pear and Sapodilla, for instance, have by no means popular estimation unanimous in their favour. A correspondent has recently expressed surprise to me that the Sapodilla is not more cultivated in Ceylon than it is, it being in his estimation the most delicious fruit he had ever tasted in the West Indies. Another correspondent, in Cuba, considers we lose a great treat in Ceylon by not growing a fruit called "Mamoncillo" (known botanically as *Melicocca bijuga*), while an enthusiastic friend in California anticipates that one of the most promising fruits of the future for warm countries is Feijoa (*Feijoa Sellowiana*), to which has been given the popular name of "Pineapple Guava," as indicating its flavour. This may sound tantalizing, but, without disparaging the fruit in question, I would sound a note of warning against alluring names. Persons who are not, for instance, familiar with the Lovi-lovi and the Nam-nam fruits and expect something exquisitely nice, will be surprised to know that these may be relied upon to bring water to the eyes rather than to the mouth. It will thus be seen that the question of what fruits are worth growing is to some extent a matter of individual taste.

From the foregoing remarks it would seem as if there was some need of edu-

cating the public taste to the proper value of the best kinds of tropical fruits. It is said regarding some that if you don't succeed at first, try again ; it being considered necessary in the case of the durian, for example, to make three attempts before one can command real success. There is obviously no ground for casting aspersions on tropical fruits as a whole, as is sometimes done,—usually by persons who are imperfectly acquainted with the best of them. It should be remembered that an acquired taste is sometimes essential in order to properly enjoy these. A visitor whom I have recently introduced to the Mangosteen remarked that, if this was one of the best fruits of the tropics, he did not wish to see a less superior one. But it transpired that, in ignorance, he had tried to eat the thick purplish rind and discarded the edible portion as the seeds ! The pineapple, cherimoyer, and mangosteen have been described as the three finest fruits in the world, and have long been the envy of people who live in temperate countries. To these fruits might be added others, perhaps of equal merit, such as the best varieties of mangoes and bananas. There is no denying the fact, nevertheless, that much can and should be done to improve the quality and thereby the reputation of our tropical fruits as a whole ; that is, by better cultivation, more careful selection of the best varieties, and by weeding out many of the inferior sorts which occupy space to the exclusion of more valuable kinds.

These remarks apply, of course, to fruit grown and consumed locally, there being no export trade hitherto from Ceylon, though it is hoped the recent flotation of a local enterprising company for canning fruit will be the means of promoting systematic fruit-growing. As is well-known to those who have tried, fruit cultivation in Ceylon on commercial lines has so far failed to meet with sufficient inducement, owing largely no doubt to difficulties of transport and of reaching consumers who will pay remunerative prices. These are obstacles, however, which only time will overcome. There is no doubt that the demand for fresh fruit is increasing, but the supply is at present so limited and irregular that profitable prices cannot be relied upon to accrue to the grower.

We are all fruit-eaters by nature, and I have read in a local paper the other day that fruit is a great aid to beauty, "preserving an indescribable look of youth, bright eyes, living hair and a fresh vital complexion." Few people in Ceylon would not grow some fruits or other around their bungalow, but many are prevented from doing so by want of a proper knowledge of what kinds to plant and how to grow them. In making a selection for planting, one should consider, in addition to other special qualities, the seasons of fruiting, so as to secure a crop during as great a part of the year as possible. It should also be remembered that, as in small gardens, though space for trees cannot be afforded, this can hardly be too limited for growing a few pineapples, papaws and plantains. In addition to the fact that they require but comparatively little space, these have also the advantage of producing a crop in from one to two years from the time of planting. Permanent trees, on the other hand, have the advantage of providing shade and ornament, whilst they require less care in cultivation when once well established.

A selection of the best kinds would include the following, omitting the more fanciful sorts, viz :—

FRUITS FOR THE LOW-COUNTRY,

(*a*) Herbaceous, quick growing kinds, including pineapples, plantains, and papaws.

(*b*) Woody, or permanent trees :—Mangoes, oranges, mangosteens, avocado pear, sapodilla, rambutan, and litchi, to which may be added durian according to taste.

All these thrive in the low country, and all are worth growing as fruits, either for one's private needs or for the local markets.

PINEAPPLES

should of course find a place in every garden. They can be grown to perfection in the low-country, and moderately well up to 1,000 feet in sheltered valleys. Well-drained loam or jungle soil, under the partial shade of trees produces the largest and most luscious fruits. The variety known as "Kew-pine," or "Smooth Cayenne," has a large and very juicy fruit and spineless leaves. A similar variety called "Bracomorensis," recently established at Peradeniya, also bears large juicy fruits, but is not an improvement on the Kew pine.

PLANTAINS OR BANANAS.

Though most of these are generally looked upon here as an article of food rather than as a fruit, some varieties are delicious, and probably few bungalows would ever be without them if they could be regularly procured. The "Suwandale" and "Kolikuttu" varieties

when well-grown are all that could be desired in a perfect banana.

PAPAWS, OR TREE MELONS.

These large fleshy fruits, which are oblong or round in shape, with a hollow centre, are much relished by most people. The soft fleshy pulp is entirely devoid of fibre, and is considered to have valuable peptic properties. It is especially useful as a constituent of fruit salads.

MANGOES.

The cultivation of the best varieties of these—the Fruit of the East—should be encouraged, whilst all inferior varieties should, if practicable, be destroyed. The best mangoes can hardly be surpassed as a fruit, but the common sorts which are so much consumed by the poorer classes in a half-ripened condition are considered to be the cause of a good deal of sickness and blood impurities. There are many first-rate varieties that are well worth growing, which are too numerous to mention. Only grafted plants obtained from a reliable source should be planted. The "Rupee Mango" is a distinct local variety which thrives in the moist low-country. It bears large roundish luscious fruits which are free of fibre, and is remarkable for its power of propagating true from seed.

ORANGES.

Excellent oranges are sometimes met with in the low-country, and also up-country, but the best reach the markets only in rare instances. Though we do not appear to have the ideal climate for rare oranges, yet there are some excellent acclimatized varieties which may be grown in the low-country to great perfection.

MANGOSTEEN.

This delicate and general favourite may be considered rather as a fancy fruit, first because of the price usually demanded for it, and secondly, because it contains so little that is edible. The tree thrives best in deep well-drained, but moist soil. It is a slow-grower, and takes seven to eight years to bear fruit.

SAPODILLA, NASEEBERY, OR CHIKU.

A round or oblong fruit, of the size of a small apple or a hen's egg, produced by a small and slow-growing tree of the guttah family. It is a delicious fruit when perfectly ripe, of the consistency of a pear, and is well-worth growing in the low-country. The tree is grown more or less commonly in Bengal, and the fruits are frequently palmed off in the Calcutta markets as mangosteens, to which, however, they have no resemblance.

AVOCADO PEAR.

This is rather a salad than a desert fruit, but is nevertheless much relished by many people. It is not grown nearly so much as it deserves to be. In recent years it has become a very popular fruit in America, where its cultivation has been much taken up in the south to supply the northern markets. There are many varieties recognised, but we have already excellent ones in Ceylon, bearing fruits weighing over 2 or 3 lbs. The tree is of easy cultivation, prefering well-drained loamy soil on sloping ground, and comes into bearing in four to five years from the time of planting.

RAMBUTAN.

My selection would be incomplete without this distinct fruit. But it is not a tree suited to a small area, being of a large spreading habit. Its burr-like orange-yellow fruits are, however, ornamental as well as of a pleasant acid taste. Some varieties are quite superior to others, both in the quality of the fruit and prolificness.

LITCHI, OR LITCHEE.

It is rather remarkable that so striking a fruit as this, which is a native of China, has scarcely become known in Ceylon yet, while it is commonly cultivated and appreciated in Mauritius and in India. It is a much esteemed fruit in its native country, whence it is exported in a dried state to London and elsewhere.

FRUITS FOR UP-COUNTRY.

Unfortunately English fruits, with perhaps the exception of indifferent strawberries, cooking pears and peaches, have after repeated trials failed to succeed up-country. There are, however, some sub-tropical kinds of quite good quality which are well-worth extended cultivation. The following are deserving of a place around every up-country bungalow. The order in which they are given is not, of course, intended to be exactly according to merit.

CHERIMOYER.

A delicious fruit, borne by a small spreading tree of the Custard-apple family. The tree grows to perfection in sheltered valleys up to about 5,000 feet elevation. Excellent specimens may be seen on Albion Estate, near Nuwara Eliya, where fruits up to 3 or 4 pounds in weight are produced in profusion, usually in the months of October to January.

ORANGES.

Imported grafted varieties thrive and give good crops up to about 5,000 feet,

and are, of course, worth a foremost place in a selection.

TREE-TOMATO.

A small herbaceous tree, of the tomato family, originally introduced from South America, bearing a profusion of fleshy egg-shaped fruits, yellowish-red when ripe. There is also a variety which bears purplish-red fruits. Though rather acid for use as dessert, these fruits are excellent for stewing, &c. The tree is easily grown, up to 6,000 feet elevation, and no garden should be without it.

PURPLE GUAVA, OR CHINA GUAVA.

Guavas are not, as a rule, particularly palatable, but this species may be said to be an exception, being distinct from all others and bearing a profusion of small round fruits, which are purplish-red when ripe and of a pleasant acid taste. The tree thrives at moderate to high elevations, is readily propagated from seed, and produces two crops a year. The fruit makes excellent jam or jelly.

CAPE GOOSEBERRY.

Although this is sometimes found flourishing in a semi-wild state near some up-country bungalows, few people who have tasted the round pleasantly flavoured berries will deny it is well worth a place in the garden. It is a low straggling quick-growing herbaceous plant, producing its berries concealed in a wrapper of its leafy calyx. The fruit makes a delicious jam, quite superior to that of the English gooseberries, and is thus an article of export from South Africa.

PASSION-FRUIT.

This ever-green climber grows so readily and without any attention, producing its egg-shaped fruit in great abundance, that it may well be recommended to any estate which does not already possess it. It may be planted as a screen on fences, or against unserviceable trees, &c. Its principal season is from May to July.

FEIJOA, OR PINEAPPLE-GUAVA.

A shrub of the myrtle family, native of Brazil, recently brought under cultivation in California for its fruit. The latter is of the size and shape of a hen's egg, and is said to be suitable for dessert, or for stewing, crystallising, or making into jams or jellies, in any of which it is described as delicious. The plant comes into bearing the third or fourth year from seed.

FRUITS FOR THE DRY DISTRICTS.

Practically all the fruits that are given for low elevations will also thrive in the drier districts, provided good soil and drainage and sufficient moisture at the roots are available. With irrigation the dry districts are in fact more suitable for fruit culture than the wet regions, a dry climate favouring the setting of fruit, as well as the development of their best flavour and even of their proper colour.

The Grape vine flourishes and produces good crops in northern part of Ceylon, while it entirely fails in the wetter districts. Almost the same may be said of melons, which are especially adapted to a dry climate.

PASSION FRUIT CULTURE.

By J. FARRELL,
Orchard Supervisor.

(From the *Journal of the Department of Agriculture of Victoria*, Vol. IX., Part 9, September, 1911.)

Owing to the increasing demand for Passion Fruit (*Passiflora edulis*), the area under passion vines, particularly in the Wandin district, is being considerably increased. There are at present many new blocks of land being prepared for planting, and growers look forward with confidence to the further successful establishment of local and export markets for this fruit.

The crop was heavy this season, and consequently prices were somewhat lower than usual at the commencement. Towards the end of the season, however, they recovered to such an extent, on the whole, growers obtained a fair average return.

PREPARATION OF SOIL.

Soil of a deep loose chocolate nature is the most suitable. The Wandin district is particularly adapted for passion fruit culture. The plants thrive best on new land, and on elevated positions are less affected by frosts than when grown on low lying ones. After clearing operations have been completed, the land should be ploughed and allowed to remain fallow for one year. The following year, prior to planting out, the soil should be well worked and kept free from weeds. When it is intended to plant on land which has been previously cropped, it is only necessary that the soil be kept in a good state of cultivation.

RAISING YOUNG PLANTS.

Young plants are raised from seeds which should be saved from fruit which ripen during May or June. These seeds give a higher percentage of germination

than those taken from fruit which ripen earlier. They may be sown during September in pots, boxes, or in drills, and covered with 1 in. of soil. The seeds may be sown thickly; and, when the plants are about 2 in. high, the weaker ones may be thinned out so as to leave a space ot about 3 in. between the remaining plants. Growers who determine on extending their blocks rarely find it necessary to sow seed in order to obtain the plants required; a sufficient number invariably grows amongst the old vines as a result of the falling of ripe fruit. The seed bed should be kept well watered during dry weather.

PLANTING OUT.

The young vines are generally planted out when one or two years old, and usually towards the end of September or early in October, when the frosts have disappeared.

Post and wire trellises, from 5 ft. to 7 ft. high, are erected to support the plants. The posts are made of rough split timber, ranging from 6 in. × 6 in. 8 in. × 8 in., with four or five wires, ordinary or galvanized, and from 8 to 10 gauge. The posts are usually put 3 ft. in the ground.

The distances of the trellises apart, also the distances between the posts, are regulated by the method intended to be adopted when planting out. There is a great diversity of opinion among growers as to most suitable distances between the rows and between the vines in the rows. Those mostly adopted by the Wandin growers are 12 ft. ×16 ft., 12 ft. ×18 ft., or 12 ft. ×20 ft. Others plant 9 ft. ×12 ft. or 9 ft. ×14 ft., but these are too close and do not admit of sufficient light and air, particularly when the trellises are over 5 ft. high. Last season a young grower planted 16 ft. ×16 ft., but this method is regarded by the more experienced growers as a waste of ground.

THE TRELLIS.

After giving due consideration to the various methods of planting out, I would recommend 12 ft. ×18 ft., *i.e.*, 12 ft. between the rows or trellises and 18 ft. between the plants in the rows. The accompanying rough sketch* will serve to illustrate the kind of trellis which is recommended to be used in conjuction with this method of planting. No attempt has been made to draw to scale, not to draw the plants beyond giving a rough idea of the position taken up by the leaders.

* Not reproduced.

The trellis illustrated is 6 ft. high with 6 in. × 6 in. posts 18 ft. apart. The end posts are 8 in. × 8 in. The post marked 1 is an extra one and is 8 ft. from the end post. It supports the stay (2.) The crosspiece (3.) is nailed to it and the end post. When erecting the latter, some growers put it in at angle, as at 4, but this is unnecessary if the trellis be properly erected. In this trellis five galvanized No. 10 gauge wires are shown. A few growers use four wres of No. 8 gauge. Although this makes a good trellis I prefer that illustrated.

TRELLIS FOR PASSION FRUIT PLANTS.

Occasionally, growers plant the young vines one or two years before erecting the trellis and allow them to lie on the ground all that time as at (*a*). This method is to be deprecated, as too many light and useless leaders are produced, and they must be afterwards cut away when the plant is being put on the wires.

But if the young plant one year old (*b*) is sown at the end of September, when the frosts are over, a fair growth is produced by the following February (*c*.) The plant may then be put up. The natural habit of the passion is for its leaders to take hold with their tendrils and climb; by placing them on the wires Nature is assisted. A plant two or three years old is shown at (*d*). Its leaders are few, but are healthy and strong as compared with (*a*) and its greater number of weak leaders on the ground.

Prior to putting the plants on the wires, saplings about ¾ in. in diameter at the butts should be woven about 18 in. apart, one against the other, into the wires, on the principle of wicker work (*b*). The butt ends should be kept uppermost; if put in butt downwards, the vibration of the wires would cause them to drop. The saplings make the trellis firm and afford the plants a support on which to climb from wire to wire.

CULTIVATION AND MANURING.

The soil around the young plants, after planting out, should be kept well worked so as to destroy weeds and conserve moisture. They should be copiously watered as often as required during dry weather.

A little stable manure should be dug in around the young plants; and providing the soil be kept well worked, an occasioual sparkling of bonedust and superphosphate will be all that is necessary to maintain vigorous growth.

To obtain heavy crops from plants in bearing, intense culture, with a fair

amount of manure, is essential. The land between the trellises should be ploughed at least twice a year and harrowed regularly, particularly after rain during summer and autumn. A spring-tooth harrow is very useful for the purpose.

A liberal supply of stable manure, when plentiful, should be given; if not, artificial manure as recommended for young plants should be used at the rate of 4 lbs. per plant or 8 cwts. per acre and harrowed in during early spring.

PRUNING.

The vines should not be pruned until the frosts have disappeared. Young plants suffer badly from frost. They should be protected for the first two years by branches of evergreen trees being placed around them; old hessian also serves the purpose. When a young plant becomes frost-bitten, the diseased parts should be removed with a sharp knife; the cut should be made about ½ in. into the sound wood. If any of the diseased wood be allowed to remain, decay continues.

Superfluous wood and foliage should be allowed to remain on the older vines until after the frosts are over, as they help to save the vines. They may then be removed with advantage.

DISEASES.

Old passion vines are very subject to Collar Rot (*Fusarium*). This disease is more easily contracted, and is more difficult to deal with, when the plants are allowed to establish themselves by throwing up a number of leaders from or below the surface of the ground (*e*). The stems should be kept clean and about 3 in, long, like (*f*). This can only be satisfactorily done by putting the plants on the wires while young, and thus rendering the work in connection with their requirements easy. This disease may be kept in check by scraping off the diseased bark at the collar and spraying with Bordeaux mixture.

Passion plants also suffer from Brown Spot of the leaf and fruit (*Glocosporium*). This disease may be suppressed by thinning out the diseased parts, and by the judicious use of Bordeaux mixture.

The vines suffer but little from insect diseases. Occasionally the stems and roots are attacked by the White Ant (*Termes australis*). These ants rarely attack young vigorous plants, but confine their attention mostly to old and decaying ones, or those which are affected with Collar Rot. Such plants should receive immediate attention, as recommended, when the ants will share the fate of the Collar Rot. If this were found to be ineffectual against the ants, kerosene emulsion might be injected into the diseased parts. Old vines which have ceased to produce remunerative crops through disease or other causes should be grubbed out and burned.

TOBACCO INDUSTRY.

ITS CULTIVATION AND FUTURE IN THE PHILIPPINES—GIVES ASSURANCE OF SPLENDID RETURNS TO CAPITAL.

(From the *Manila Bulletin.*)

Among the many industries in the Philippines that promises large returns to investors, those with small capital equally as well as to those with large capital, is the tobacco industry.

The possibilities offered for the future cultivation of tobacco and its present importance in the island industries is set forth in a very clear manner by Mr. H. M. Pitt, in Reciprocity and the Philippines.

Mr. Pitt says:—

Tobacco is grown generally throughout the Philippines. In nearly every province of the archipelago patches may be found, and the leaf is used by the people who grow it and their neighbours. The better commercial grades come for the most part from the valley of the Cagayan River, in the north part of Luzon, the island on which the city of Manila is located. This valley extends for upwards 200 miles along the river and is very sparsely populated. During the rainy season the river overflows its banks and floods the flat stretches that border it. There is thus deposited each year a natural fertilizer in the form of silt which makes the soil extremely rich. The valley being protected on the east and west by mountains, is freed from most of the winds that pass over the islands, but the result is that the weather is exceedingly warm. Conditions are thus found to be particularly favourable to the cultivation of high grade tobacco. There is so much land available in the region and the population is so small, that there is no necessity for intense cultivation, and the native settler can readily move from place to place, cultivating new ground after one or two crops have been raised on the old.

The Spanish Government formerly maintained a tobacco monopoly, and while this did not materially benefit the grower, it did tend to improve the quality of the product, as none was accepted unless of approved grade. This

monopoly was abolished in the eighties, and for a considerable period following its abolishment the bulk of the crop was exported in the leaf where before a large part had gone out in manufactured form.

The Payne-Aldrich Bill of 1909 that opened the United States markets to the Philippine tobacco, with certain limitations, proved a great incentive to the manufacturer and exporter to the United States of Philippine cigars: The amount fixed which may not be exceeded in any one year under the free entry privilege is 150,000,000 cigars, and while it is not probable that this figure will be reached for some time to come, it is proving a great stimulus to the cigar manufacturing industry in the islands.

The Filipinos are themselves large consumers of tobacco, but their taste runs to cigarettes rather than to cigars. During the fiscal year 1910 there were manufactured for local consumption 4,173,507,249 cigarettes. This presents but a part of the total consumption, as a very great number of hand-made cigarettes were consumed as is evidenced by the large importations of cigarette paper not adapted to machine use. If the consumption of home-made cigarette may be estimated at one-fourth that of the factory-made article, the daily consumption in Philippines would reach to more than 14,000,000 cigarettes, which is very close to two for every man, woman, and child in the country.

The exportation of cigarettes is comparatively small. It amounted to but 34,859,581 cigarettes in 1910. On the other hand, the cigars exported exceed in number those consumed locally. The number of cigars removed for export and domestic consumption during the past three years, according to the Report of the Collector of Internal Revenue, is as follows:—

1908	...	...	198,754,787
1909	...	...	204,649,901
1910	...	...	285,561,328

The number of cigars exported during these three years is as follows:—

1908	...	...	115,768,509
1909	...	...	117,849,381
1910	...	...	196,288,438

Prior to the enactment of the Payne-Aldrich Bill very few Manila cigars went to the United States; in 1908 the number was but 29,570; in 1909, 867·947; but in 1910, due to the opening of United States markets, the number exported to that country reached 87,281,683, which represents nearly the amount of the total increase in exports. There was a slight falling off in the exports of leaf tobacco in 1910 from 1909, due to the increased demand for manufacture into cigars and cigarettes. The figures for 1909 were 10,706 tons, valued at $1,668,234. In 1910 the amount was 9,715 tons and the value $1,598,557. During the same period the value of cigars exported increased from $1,083,702 to $2,973,630.

The manufacture of cigars and cigarettes is one of the most important industries in the city of Manila, and many thousand persons are employed in it. The industry is under the direct supervision of the health authorities, and strict sanitary regulations are enforced, both as to the persons of the workers and the premises. There are probably no tobacco factories in the world where a higher state of cleanliness is observed than in those of Manila.

The tobacco growing industry is susceptible to both improvement and increase in a very material degree. It is one that gives assurance of splendid returns to any qualified to engage in it, and it is adapted to those of moderate means as well as to the possessors of large capital.

INTERNATIONAL INSTITUTE OF AGRICULTURE.

(From the *Bulletin of Agricultural Statistics*, September, 1911.)

The Bulletin of Agricultural Statistics for September has just been issued under the direction of Prof. Umberto Ricci, by the International Institute of Agriculture.

The Bulletin contains the most recent official data received at the Institute from the various countries in regard to the production of the cereal crops in the Northern Hemisphere. The production of wheat for the present year, in the group of countries included in the Bulletin, which represent about four-fifths of the world's total wheat production, is estimated at 829,782,823 quintals as compared with a production of 825,959,642 quintals last year. The Single Numerical Statement, *i.e.*, the ratio in percentage figures between the estimated production this year and the production obtained last year is 100·5. The production for the present year supercedes that of the past year in Spain (42,600,000 quintals as compared with 37,400,000 quintals), Great Britain and Ireland (17,400,000 quinatals as compared

with 15,400,000 quintals), Hungary (52,400,000 quintals as compared with 49,400,000 quintals), Italy (52,300,000 quintals as compared with 41,700,000 quintals); and India (100,800,000 quintals as compared with 97,400,000 quintals). The production of wheat is smaller this year as compared with last year's production in Prussia (23,500,000 quintals as compared with 24,800,000 quintals), Roumania (26,000,000 quintals as compared with 30,200,000 quintals), Russia in Europe (150,900,C00 quintals as compared with 190,300,000 quintals), and in the United States (179,200,000 as compared with 189;300,000 quintals).

For the other cereals, the Single Numerical Statement for the countries considered is: for rye 96·4; barley 99·5; oats 88·9; and maize 86·6.

The two countries which, due to their poor harvests have principally contributed to the fall in the figures of the Single Numerical Statement are the United States and Russia.

The Bulletin also contains information as to the condition of the cotton crop, which in the United States and Japan promises about an average harvest, and in Egypt an outturn about 9 per cent. below the average.

Of especial interest is a comparison which has been made between the estimates of the present year's wheat production, as published by certain influential private periodicals, and the official figures published by the Institute. The differences brought to light by this comparison, and which in several instances are very considerable, illustrate the utility of the work accomplished by the Institute in thus exercising a control upon the large number of harvest estimates which are placed before the public, by furnishing, in one synthetic report, the official figures of production for the whole world.

COPRA INDUSTRY'S RAPID INCREASE.

Offers Splendid Inducements for Investment of Capital—100 Acre Plantation A Small Fortune.

(From the *Manila Bulletin*, October 2, 1911.)

The cultivation of copra offers one of the best inducements in the Philippines for the investment of capital and the great demand for copra opens a splendid market for the planter.

The copra industry is rapidly increasing and promises to soon be in the lead in local industries at the present rate of growth. Recent discoveries show that a splendid butter can be made from the coconut, while the oil of the copra is considered very valuable.

In Reciprocity and the Philippines by Mr. Harold M. Pitt, appears an interesting article on copra and its cultivation, and the possibilities offered in its cultivation for the investment of capital. Mr. Pitt says:—

Copra is the meat of the coconut from which the water has been partially or wholly evaporated. It is valuable principally for its oil content and is a product the demand for which has been increasing rapidly. The Philippines are peculiarly well adapted to its production.

The coconut tree grows readily in almost every section of the Archipelago, the most favourable localities being those adjacent to the seashore. There are many articles of general utility obtained from the tree itself and the nuts, but Copra is the most valuable, and in late years the attention of growers has been centered in its production.

At the present time the Philippines are supplying about one-third of the world's consumption of Copra. The best market has developed in Marseilles, France, where manufacturers of coconut oil have perfected methods for its reduction to a semi-solid state that permits of its use as a base for artificial butter as well as for various toilet articles. Coconut oil is also being used to a considerable extent in the place of cottonseed oil, and there are other uses for it developing from time to time which give assurance of a steadily increasing demand and a firm market.

Prior to American occupation but little attention was given here to the preparation of Copra from the meat of the nuts, and the records of Spanish times contain no mention of exports of

it. The following table from the report of the Collector of Customs shows the growth of the industry since 1899, and a study of the figures will give an idea of the increase in the value to these islands of copra as a commercial product:—

	TO ALL COUNTRIES.		Percentage of Total	TO UNITED STATES.	
	Tons.	Value.	Value.	Tons.	Value.
1899 ...	14,047	$ 656,870	4·7	—	—
1900 ...	37,081	1,690,897	7·8	—	—
1901 ...	52,529	2,648,305	10·0	103	$ 4,450
1902 ...	19,686	1,001,656	3·6	—	7
1903 ...	97,629	4,472,679	11·2	61	9,173
1904 ...	54,132	2,527,019	7·0	174	9,231
1905 ...	37,556	2,095,352	5·6	205	14,425
1906 ...	66,157	4,043,115	12·3	—	—
1907 ...	49,081	4,053,193	11·8	1,109	108,086
1908 ...	76,419	5,461,680	16·6	2,967	228,565
1909 ...	105,564	6,657,740	21·1	4,713	287,484
1910 ...	116,374	9,153,951	22·9	5,538	447,145

The business of growing coconuts is one that offers splendid inducements for the investment of capital. Trees will mature in from 7 to 10 years. At the latter age they should be producing an average of from 60 to 70 nuts a year. From 200 to 250 nuts are required to make one picul of Copra, equal to about 13½ pounds. This is worth in the neighbourhood of $5, and the market is usually above this figure. The net profits from matured trees should not be less than $1 gold per annum for each tree. They may be planted 50 to the acre—or, if they are a little more widely separated, it is better. This permits of the cultivation between them of minor crops during the period of growth of the trees: thus corn and various leguminous plants may be cultivated and made to support the planter until his trees begin to bear. A 100-acre tract with, say, 4,500 bearing coconut trees is sufficient to make a man comparatively rich. That a very small amount of copra has gone to the United States is probably due to the fact that Marseilles has possessed certain advantages in the manufacture of the oil and various by-products, but the large ratio of increase that has taken place in exports to the United States in the past two years would indicate that a market is being developed there, and it is probable that in time that country will either get its coconut oil from the Philippines or manufacture it from Philippine Copra, instead of buying it from France as it is at present doing.

There would seem to be a splendid opportunity present in these Islands for the manufacture of coconut oil and the by-products of copra and the coconut. The husk of the latter yields a fibre that is valuable for manufacture into brushes, door-mats and a slightly inferior quality of rope. It can be produced at a small cost and will add very materially to the profits from a coconut plantation. The shell of the nut makes a high grade charcoal, and what is commonly known as the milk is capable of producing a fair quality vinegar. The residue of the meat from which the oil has been extracted is valuable as food for cattle or for fertilizing.

Under methods at present in vogue in these Islands no attempt is made to utilize any of these by-products.

SUGAR CULTIVATION IN THE PHILIPPINES.

History of Industry in Islands—Possibilities Offered for Investment of Capital.

(From the *Manila Bulletin.*)

Sugar cultivation in the Philippine Islands and the possibilities offered here for the investment of capital, the necessity for modern methods of extraction and market afforded, is given special attention in "Reciprocity and the Philippines," and should be placed in the hands of those who control the sugar capital in the United States.

In dealing with the subject Mr. Harold M. Pitt, author of the work above mentioned, say:—

The Philippines have been producing Cane Sugar for export for considerably more than a century. The cane appears to have been introduced by the Chinese in earlier times, and most of the old mills at present in use are built along Chinese methods. The first authentic record that we have of the production of cane sugar in the Islands is contained in United States reports dating back to 1795, when 296,219 pounds of Philippine

sugar was included in the list of imports. For many years the industry was confined to provinces near Manilla on the Island of Luzon, but shortly subsequent to the period in which the Crimean War occurred a great impetus appears to have been given to it due to a largely increased use of sugar by the European nations. The Industry was then extended into the islands of the Visayan group, and the western half of the Island of Negros known as Negros Occidental, grew to be its centre. As early as 1854 the exports of sugar from the Philippines reached the very respectable figure of 47,000 tons, valued at $2,225,022, and in that year it constituted 33·07% of the total exports. The period from 1890 to 1894 witnessed the full development of the cane sugar producing industry in the Philippines. The average of the annual exports for those five years amounted to over 200,000 tons of a stated value of $7,535,838. Up to this period the cane sugar in common use throughout the world was of the classes termed Muscovados and Molasses.

It was at about this time that the Beet Sugar industry began to reach a high state of development in Europe, and as beet sugar is turned out in refined form, a demand was created for a higher quality of cane sugar than that previously in general use. This gave an impetus to the cane sugar refining business on which the so-called Trust has been developed in the United States. Refiners of cane sugar demanded a higher quality of the raw product, and this necessitated better mills. Most cane-growing countries were able to meet this demand, but the Philippines—on account of the outbreak of the insurrection against Spain which came to a head in 1896 and the subsequent entrance of the United States into the islands; later the outbreak against United States authority, and after that, as if to complete the demoralization of industry. an epidemic of Rinderpest which destroyed upwards of 80% of the work animals of the plantations—were unable to keep pace with the improvements that were taking place in the industry elsewhere, and as a result the production of sugar declined rapidly from the plane that it reached in the early nineties.

In 1902 Congress enacted a law which admitted Philippine products into the United States under a duty 25% below regular rates. This, however, did not prove a sufficient inducement to draw the outside capital necessary for the rehabilitation of the industry. It was not until the enactment of the Payne-Aldrich Bill in 1909 that any material relief was afforded. This bill provided for the free entry into the United States markets of Philippine sugar to an amount each year not exceeding 300,000 gross tons. As the duty in the United States on a 96 degree test sugar is $1·68½ per 100 lbs., the effect of this law has been to greatly advance the price of the better grades of sugar produced here. While very little has thus far been manufactured that goes above 88 degrees test, this is greatly benefited in price, and the lower grades ranging down to 75 degrees, that are consumed locally or are marketed in China for consumption in raw state have participated in some measure in the advantage enjoyed through free access to United States markets, as all of the better grades are removed from competition in supplying this near-by demand. Very little of the low grade sugars go to the United States.

For several years past the annual production of sugar in the Philippines has ranged around from 150 to 175,000 tons. It is estimated that from 40,000 to 50,000 tons of this was consumed in the islands, which has left in the neighbourhood of 125,000 tons available for export. Prior to the enactment of the Payne-Aldrich Bill the greater part of the sugar exported went to China, but since that Act went into effect the exports to the United States have increased very materially, and during the fiscal year 1910 94,000 tons out of a total of 127,000 tons exported went to the United States, while about 30,000 tons went to Hongkong and China proper. For the fiscal year 1911 exports increased to 149,000 tons, nearly seven-eighths of which went to the United States. While there is naturally a great benefit derived by reason of the law providing for free entry of Philippine sugar into the United States, the limitation imposed has undoubtedly been a decided hindrance to the development of the industry. It is true that the amount fixed is above what the islands have ever produced, yet the fact is always present that it is easily possible to exceed that limit, in which case the surplus product would have to be sold on the basis of the world's price, and the effect would be to place the Philippine grower in the power of the American refiner. This has discouraged American capital that otherwise might reasonably be expected to invest in the industry in the Philippines. There are certain sections of the islands that are particularly well adapted to the production of sugar, and the industry gives assurance of very substantial profits, but so long as the limitation remains it will prove a great deterrent to the investment of

capital in the industry to any considerable extent.

There has been some improvement noticeable in the methods pursued by planters since a better price was assured them by reason of the availability of the United States markets. Also, there has been one large enterprise started that will add materially to the cultivated area as well as introduce a new standard of quality and grade of the sugar produced.

The methods employed here generally in the cultivation, manufacture and packing of sugar are extremely primitive and will admit of very material improvement. In preparing the soil for cultivation a plough is used that overturns the earth to a depth of only 4 to 6 inches, whereas modern methods require at least 18 inches to 2 feet of ploughing. Rows are planted very close together, which do not permit of good cultivation, and the mills are as a rule of an obsolete type, recovering from the grinding of the cane an average of not more than 65% of the juice content, and it sometimes goes as low as 50%. Modern mills extract 94 to 99% of the juice contained in the cane. The residue from the cane after crushing has to be dried for some time in the sun before it can be burned. In modern mills it is practically dry as it leaves the rollers and is conveyed automatically to the furnaces where it furnishes all necessary fuel, It can readily be seen that an immense saving is possible with modern methods substituted for those now in use, but modern sugar mills are expensive affairs and are beyond the reach of the average planter. The natural solution of existing difficulties would appear to be central that has developed so largely in the industry in Porto Rico and Cuba. The shortness of the cutting season in the Philippines, however, renders it difficult to obtain capital for a large mill of this kind, for the reason that it would be next to impossible to obtain the co-operation of enough planters in any one neighbourhood to insure a continuous supply of cane during the 100 to 120 days that a mill can be operated.

The sugar industry in the Philippines requires large capital, but the returns that may be counted upon with assurance are so great that it should invite the attention of investors who are conversant with it. The cane will mature here in from 12 to 15 months, while 20 months and upwards are necessary to its growth in Hawaii. There is reasonably sure rainfall on which the Filipino always depends, but irrigation would doubtless increase the production and improve the cane when grown. Scientific fertilization is practically unknown in the islands, but the use of fertilizers and more care given to the cultivation of the cane would insure a much greater yield. The industry awaits the application of proper methods, and that it has not received from American capital the attention that it merits would appear to be a reflection on the farsightedness of those who control that capital.

MISCELLANEOUS PRODUCTS.

THE LAC INDUSTRY.

(From the *Indian Agriculturist*, Vol. XXXVI., No. 3, March 1, 1911.)

Part III, Vol. I, of the *Indian Forest Memoirs* is devoted to a note on the lac insect, its life history, propagation, and collection, by Mr. E. P. Stebbing, Deputy Conservator of Forests, Bengal Division. The present memoir is a revision and enlargement of a monograph on the lac insect published in 1908, which is now out of print. The necessity for the new edition has arisen from the great impetus which the cultivation has received owing to the largely increased demand for lac. This increased demand is mainly attributable to export influence, as though lac enters very largely into the agricultural, commercial, artistic, manufacturing and domestic affairs of the people of India, it was not till shellac, which is the manufactured form of lac, came to be largely used in electrical work, the manufacture of gramophone records, as a stiffening material for hats, as an ingredient in lithographic ink, and as sealing wax, in Europe and America, that the question of the supply of lac assumed a position of importance. Concurrently with this enlargement of its use, the quantities of lac exported by sea to foreign countries enormously increased. Calcutta is the principal exporting centre, and the amount sent out from that port increased from 82,038 cwts. in 1878-9 to 102,686 cwts. in 1888-9, to 178,722 cwts. in 1898-9, and to 377,317 cwts. in 1908-9.

This change means a vastly increased production, but with this increased production has come a diminution in price, so that shellac which in 1907-8 was valued at Rs.112 per cwt., in 1908-9 fetched only Rs.73 per cwt. Thus it would appear that the production of lac has caught up to the demand, and that any increase in production to be profitable must be accompanied by a decrease in the cost of production. Mr. Stebbing's note would appear to have been compiled before this change of price declared itself, as the author says that "the question of lac cultivation has once again come to the front owing to the remarkable increase in the price of the article, a rise in price which has been a natural concomitant of a demand exceeding the supply, attributable to the extensive use of shellac in electrical work and in the manufacture of gramaphone records. As far as can at present be judged there appears accordingly no reason why the demand for the product should not continue to increase, and this probability would seem to call for prompt and urgent action, both on the part of those already interested in the cultivation, and of those who, by introducing it into areas in which it is at present unknown, can thus improve the pecuniary value of the lands and add to the prosperity of the ryot." But if the supply of lac has now caught up with the demand, any steps taken to increase its area of production are hardly likely to be attended with a large pecuniary return.

Mr. Stebbing's note is of the greatest interest and value as a complete study of an important natural industry. The illustrations of the lac insect, and of the insects which are injurious to the lac insect, are exceedingly good, and the whole subject has been treated in a clear and methodical way. The author describes the origin and nature of lac, which as is well-known is a resinous incrustation excreted by an insect, and the history and the growth of the industry. He then describes the insect and its life history, the food on which it lives, and its enemies. He goes on to show how widely the lac insect is distributed throughout the Indian continent, and the variety of different trees on which it exists. A peculiarity of this distribution is that whereas the insect flourishes best on one or more species of tree in one locality, in a different part of the country it will be found to thrive best on other species, even though the trees upon which it does best in the former area may be present in the latter. The author has investigated the distribution of the insect in the various presidencies and provinces of India, and indicates the trees upon which it thrives best in different localities. After this the method of cultivation and propagation is considered. Native methods of cultivation and collection are extremely careless and slovenly, and the cultivation and propagation of the insect on scientific lines has been receiving considerable attention. The insects swarm in February and in the last week of June, the lac being collected during June and from the middle of December to the middle of January, before swarming takes place. About 10 per cent. of the crop is kept as seedlac, special trees being reserved or a portion of the crop being left on each tree. When swarming time approaches the twigs covered with lac are loosely wrapped in rice straw and are tied on to other uninfected branches. This provision of bridges to enable the swarming larvæ to reach unincrusted branches is of the utmost importance. Nature's method to ensure the continuance of the species has been the production of a very large number of offspring owing to the certainty of large numbers perishing in the effort to reach suitable feeding places, and man by assisting this operation turns to his own advantage this great profusion of offspring. The author describes the collection of lac, its preparation for sale, its treatment in the factory, and the manufacture of shellac; lastly, he shows that both in the cultivation and the collection of the lac large improvements are possible.

DEVELOPMENT OF BEJUCO INDUSTRY.

WILL IN TIME DEVELOP GREAT VALUE FOR EXPORT—ABUNDANCE AVAILABLE THROUGHOUT ISLANDS.

(From the *Manila Bulletin.*)

Bejuco is beginning to enter into the export trade of the Philippines and promises in time to develop a great value for export, while at the same time there are numerous uses to which bejuco is put in the local market.

The bejuco industry is given notice in "Reciprocity and the Philippines," by Mr. Harold M. Pitt, as follows :—

Among the natural products of the Philippines that are beginning to enter into the islands is Bejuco, a vine commonly known as rattan, which flourishes in most of the forests of the archipelago, and often grows to be from 600 to 700 feet long. This vine is split into narrow

strips, and the product, bejuco, is used in a great many ways by the natives. It is very tough and serves as a substitute for various forms of cane in the manufacture of furniture, in the place of nails for binding together the timbers of houses, and for fastening the timbers of bridges and other forms of construction. It also takes the place of rope and twine in all of the uses to which those articles are put.

There is an abundance available and it can be gathered at small cost. It is a product that will in time develop a great value for export, as well as continuing in general use by the Filipinos.

PLANT SANITATION.

MYCOLOGY IN RELATION TO ADMINISTRATION.

(From the *Louisiana Planter and Sugar Manufacturer*, Vol. XLVII., No. 4, 22, 1911.)

The systematic study of the disease of plants and its application to general agriculture has developed almost entirely within the last sixty years. Although the existence of varions fungi has been recognized for many centuries, yet little if anything was known of their real nature until the middle of last century. Their life histories were almost entirely unstudied, and many of them were believed to be abnormal developments of the leaves and other parts of flowering plants. Under such circumstances it was only natural that nothing should be known of their connection with plant diseases, and the latter were generally attributed to bad soil conditions, the occurrence of excessive rains or drought, and similar factors. In some instances, where large insects, such as the larvæ of beetles, or of moths and butterflies, were found in considerable numbers in connection with disease, it was realised that these were the cause, while in others, when the disease was of a violently epidemic nature, it was usually said that the plants were destroyed by a blight. Instances of this are the blights reported at various times on cacao in Trinidad, and they are said to have destroyed the coco-nut palm in Antigua. The use of the term "blight," referring as it does only to the general appearance of the affected plants, shows clearly the complete lack of information that existed among planters and farmers as to the real cause of the appearance. This lack of information continued even up to very recent times; while the confusion between insects and fungi, which occurred among eminent scientific men as late as the forties of the last century, may be found among planters at the present day. There is, however, much excuse for this, as no means were in existence until comparatively very recent years, for rendering available to the practical man, to whom it was of so much importance, the information that was being rapidly accumulated by scientific investigators.

The real recognition of the important part played by fungi in connection with plant disease dates from the publication in 1866 of De Bary's book on the comparative morphology and physiology of the fuugi, in which details of life-history and parasitism in the case of many forms are clearly set forth. This gave a great stimulus to many investigators, so that during the subsequent thirty years an immense mass of information was accumulated both in connection with the life-histories and pathological importance of many species, and with their systematic classification and the nature of their reproductive arrangements. It should, however, be borne in mind that practically the whole of the work was carried out by private individuals, either working in their own laboratories or in those of various universities and academic institutions throughout the world. As a consequence of this, the information obtained was only available through the medium of the more advanced teaching establishments or of the universities, to those engaged in the study of Natural Science, and its importance from a much wider agricultural point of view was not fully recognized. Along with this development in the knowledge of their parasites went a very rapid increase in the understanding of the nature of plants themselves, so that by about the year 1880 there was accumulated large stores of knowledge available for the right direction of a campaign against plant diseases.

Once the information had been obtained, the next step from the agricultural standpoint was to render it useful to the planting community. This was done by the recognition by Governments of the importance of the work that could be performed. In England such recognition consisted for a long time of the employment of a

research Mycologist on the Staff of the Royal Botanic Gardens, Kew. One of the first countries in which prominence was given by the Government to the practical application of mycological knowledge would appear to have been the United States. For the last thirty years this country has been employing an ever-increasing number of plant pathologists in connection with the Department of Agriculture of the Federal Government; while at the present time almost every State Experiment Station, supported largely from the funds of that State, has one or more Mycologists on its staff.

When the Imperial Department of Agriculture was founded in 1898, it soon became evident that officers capable of dealing with the pests and diseases of plants were urgently needed, and this was well emphasized by the prevalent diseases of the sugar-cane. About the same time it became necessary to appoint a Mycologist on the Staff of the Royal Botanic Gardens at Peradeniya in Ceylon, and at the present time almost every Government Department of Agriculture in the British Empire employs one or more such officers. In India, not only is there an Imperial Mycologist to the Government of India, aided by an assistant Mycologist and several research students, but one at least of the Presidencies, Madras, has its own officer. Instances of the employment of Government Mycologists could be added from all parts of the world.

These Departments of Agriculture bring about the dissemination of what is known in connection with fungi in two ways. They work directly through the association with planters of the scientific officers on their staffs, and indirectly by means of the publications; while at the same time, owing to their connection with the Government, they are able to introduce the teaching of the requisite scientific knowledge into the curricula of the schools. This last point serves to emphasize the importance that attaches to the connection of scientific knowledge with so thorough an instrument for inducing its spread as is provided in the form of the various Governments.

Further valuable assistance in the protection of plants from disease is rendered by Governments through the legislation which they are empowered to enact. Such legislation can prevent the importation, into any given country, of diseases likely to cause serious damage to its crops. At the same time it can enforce, if necessary, the adoption of adequate measures for eliminating or eradicating the more serious diseases which do exist. In both these cases the technical knowledge of the scientist is necessary, though this alone is powerless without the aid of the Government machinery for enforcing the necessary measures, and without the general appreciation of the reasonableness and wisdom of the measures on the part of the community.

The recognition of the importance of mycology on the part of Governments has been followed by similar recognition on that of the general public. As a consequence of this, there exist to-day several associations of planters, and more than one private company engaged in agriculture, who maintain a scientific staff, including a plant pathologist, at their own expense. The Hawaiian Sugar Planters' Associations may be cited as an instance of this. Moreover, the tendency on the part of private companies to employ their own Mycologist is distinctly increasing. This tendency, although a step in the right direction, is not to be advocated without qualification. There is considerable probability that the money necessary would be much better spent in contributing to the maintenance of a large number of such officers on the staffs of the various Government Departments. There are several reasons for this. In the first place, it is far easier to work in a large and properly-equipped central laboratory than in small isolated ones. At the same time the work receives material assistance from the concentration of effort, the free access to literature from all parts of the world. containing information on mycological subjects, and the sympathetic intercourse between men engaged in similar study, all of which are only obtainable at a central laboratory.

The increasing demand for plant pathologists makes it important that some sufficient means should be found for supplying properly trained men, and in this it would be of great assistance if the universities would provide adequate courses of instruction, not only in the methods of mycology and in those of its application, but also in general tropical agriculture. The demand for such men will, in course of time, become limited, but it will always be constant. Such a training might with advantage be followed by a year's research work at the laboratory of one of the tropical Departments of Agriculture. Facilities for this exist at Pusa, in India, and also in Ceylon and Java for the East, and in the Imperial Department of Agriculture for the West.

Although very rapid progress has been made in recent years, both in the actual knowledge of plant diseases, and in the recognition by the world at large, and by Governments in particular, of the importance of this, yet much more work must be done, and many more men must be employed, before the full advantage of the scientific knowledge which is even now available can be obtained by agricultural communities.

THE CONTROL OF SCALE INSECTS IN THE BRITISH WEST INDIES BY MEANS OF FUNGOID PARASITES.

By F. W. South, B.A. (Cantab.), Mycologist of the Staff of the Imperial Department of Agriculture for the West Indies.

Part I.

General Account.

(From the *West Indian Bulletin*, Vol. XI., No. 1, 1910.)

Introduction.

It has been recognized for a comparatively long time, that different species of fungi are able to attack the bodies of various living insects and eventually cause their death; but the epidemic nature of this attack, that is the hundreds of thousands of individuals that may be destroyed by the fungus, together with its economic importance, whether beneficial or the reverse, has only been recognized within the last forty years. Indeed, the use of these parasites in the control of various pests is of even more recent date, and cannot yet be said to have attained the greatest application of which it is capable. In fact, it is only within the last two years that the subject has received in the West Indies the attention of which it is worthy, and it may be directly stated, that the results of the observations and experiments conducted during that time offer every prospect of success in controlling scale insect attacks by means of their fungoid parasites.

The first important step in the recognition of the effect of vegetable parasites of insects on an economic scale was the discovery of the bacterial disease of silk worms by Pasteur in 1870. The disease had occasioned considerable loss to the silk industry in France, but the recognition of its cause led to the suggestion of measures by which it could be prevented satisfactorily.

During the last twenty-seven years, in the United States of America, a considerable amount of work has been carried on having a directly opposite object, namely, the reduction of the numbers of various-insect pests by means of their vegetable parasites, both bacterial and fungoid. This work has, on the whole, met with a fair measure of success, more especially in the damper and milder climates of the more southern States. Among the insects experimented upon may be mentioned the cabbage caterpillar, the chinch bug, the grasshopper, and various species of scale insects.

The scale insects, by virtue of their stationary habit, are particularly liable to attack by fungi whose hyphæ can grow under their scales and destroy their bodies. The usefulness, from an economic point of view, of the fungi attacking these insects has been exploited to the greatest extent in the State of Florida where Professor Rolfs, of the State Experiment Station, first demonstrated in 1897 the practical application of the red-headed fungus in the control of the San José scale. Subsequent work by various members of the Experiment Station staff has added very largely to our knowledge of such fungi, and of the conditions under which they may be successfully employed. More recently, information as to the occurrence and distribution of the fungoid parasites of various scale insects has been forthcoming from different parts of the world, including Cuba, Porto Rico, Martinique, Ceylon, South Africa and Australia.

During the last year information with regard to the distribution and effectiveness of these fungi in the various West Indian Islands has been collected by the officers of the Imperial Department of Agriculture, and the results, though at present far from complete, are embodied in this article, which is intended as a preliminary discussion of the question, and an indication of the lines along which it is hoped subsequent work will be conducted. The fungi at present known to occur in these islands are: The red-headed fungus, *Sphærostilbe coccophila*, Tul.; the white-headed fungus, *Ophionectria coccicola*, E. and E.; the black fungus, *Myriangium Duriæi*, Mont.; the shield scale fungus, probably *Cephalosporium lecanii*, Zimmermann.

General Description of the Fungi found in the West Indies.

The following is a brief account of the more superficial characters of these fungi; the fuller and more technical description of them will be found in the last part of this article.

Red-headed Fungus.—This most commonly appears as a small, conical, or club-shaped outgrowth from the scale attacked; it is usually inclined at an obtuse angle to the surface of the scale, and is from $\frac{1}{40}$ to $\frac{1}{8}$ inch or $\frac{1}{2}$ to 3 millimetres in length. The end of each outgrowth is bright-red in colour and somewhat horny in consistency. This is supported on a delicate, pinkish, velvety base. As many as five or six of these outgrowths, or *sporodochia*, may arise from a single scale. They are borne on an interwoven mass of the fungal hyphæ, known as a stroma, which fills the space once occupied by the body of the dead scale insect. Another form of fructification may also be produced by the fungus. This consists of more or less spherical, smooth, bright-red perithecia, which are usually borne in groups of four or five on the same stroma as the other fruiting form. It must be remembered that the hyphæ of this fungus are colourlesss and fine, and that, consequently, when the fungus is not producing either of the forms of fructification described above, it is very hard to see, and may be present in large quantities and doing most effective work, although entirely invisible to the naked eye. Practically the only indication of its presence in this stage, visible without a microscope, is the large number of dead scale insects to be found on the host plant.

White-headed Fungus.—This also has two forms of fructification, both produced, as in the case of the red-headed fungus, on a stroma occupying the body cavity, and also frequently covering the body of the scale insect. The stroma is white or cream-coloured, and gives rise to a small, brown, cylindrical outgrowth about $\frac{1}{2}$ millimetre long. When this becomes mature, it turns white at the top, owing to the formation of a more or less conical head of white spores. The second stage consists of numerous, more or less spherical, smooth perithecia, of a coffee colour, which occur in groups on the stroma. Owing to the scattering of the conidia over the stroma, the fungus frequently appears white or grey in colour.

Black Fungus.—This appears as irregular, smooth, coal-black lumps on stems and branches of trees infected with scale insects; it rarely occurs on the leaves. The major portion of the black stroma is of a brittle nature, somewhat like charcoal, and the stroma, as a whole, is of a definite appearance. These characters serve to distinguish it from black blight to which, however, it bears in reality but little resemblance. This fungus also consists of fine, nearly colourless hyphæ in its early vegetative stages, and probably kills many more scales than those on which its stroma actually appears. While useful on the stems and branches, this fungus is more disfiguring than the scales themselves when it occurs on the fruit. No instance of its occurrence there is, however, recorded at present in these islands, though it has been known to occur on fruit in Cuba.

Shield Scale Fungus.—This differs very considerably in appearance from any of the other three, its characters being more those of a mould. In the early stages it kills the insects without any outward appearance of its presence such as would be visible to the naked eye. But when the scale is dead a white or slightly buff coloured fringe, often of a rather waxy appearance, grows out from beneath it over the surface of the leaf. The scale itself often becomes brown in colour and of a papery consistency, that is, if it is one of the soft shield scales. At an even later stage the whole surface of the scale insect becomes covered with a slightly buff-coloured coating of the fungus hyphæ, and this often has a very powdery surface owing to the presence of very numerous heads of spores. The appearance is most characteristic, and when once seen cannot easily be mistaken.

EFFECTIVENESS OF THE FUNGI.

In treating of the red-headed fungus on the San José scale in Florida, Professor Rolfs remarks that the ordinary observer would overlook it altogether. This would hardly happen in the West Indies in places where the fungus is really active, and producing numerous fructifications, as the result is to give a quite definite pink appearance to the parts affected, even when they are viewed from a short distance. The above effect has been seen by the author on lime tree stems in Dominica; it is also mentioned by the Imperial Commissioner of Agriculture as having been even more noticeable in the case of a specimen of *Castilloa elastica* at the Agricultural School, St. Lucia, on which numerous parasitized scales occurred. These instances serve as an illustration of the effectiveness of this parasite under favourable conditions. In dealing with this point in his paper on 'Fungi Parasitic upon Aleyrodes Citri,' Professor Fawcett of the Florida State Experiment Station remarks:—

"The effective work of this fungus (the red-headed fungus), and of two

others, *Ophionectria coccicola*, E. and E., and *Myriangium Duriaci*, Mont., upon the orange scales, is readily shown by spraying an orange tree very thoroughly with Bordeaux mixture. During the summer and fall of 1907, the author sprayed a number of trees with Bordeaux mixture for another purpose. The trees were sprayed very thoroughly, once in May, once in July, and once in September. Before the first spraying the trees were practically unhurt by *Mytilaspis citricola*, only a few individuals of the scale being found on any parts of the trees. After the first spraying, this scale insect began to spread, and increased slowly in numbers until November, when the trees were badly attacked by the scale. Other trees, near by that had received no spray, were as free from scale as at the first. The fungicide had evidently destroyed, on the sprayed trees, the fungi that had been all along working upon the unsprayed trees."

Another instance illustrating the same thing is that afforded by Dominica. In this island there has been no serious trouble from scale insects since the year 1903, which succeeded the drought in 1902. Observations on material from the island show that this is to a considerable extent due to the luxurious growths of parasitic fungi, which have kept the scales in check for seven consecutive years.

In their paper on 'Insects and Diseases of the Orange,' Cook and Horne remark that the black fungus (*Myriangium Duriœi*) has less effect on the orange snow scale (*Chionaspis citri*) in Cuba than any of the other fungi found there have on the insects which they attack. In Dominica, however, it would appear to be more effective, for this scale practically never assumes serious proportions in that island, and could only be said to be of secondary importance in the serious outbreak of scale insects that occurred in 1903. The black fungus is very common on this scale, and probably is responsible to a very large extent for keeping it under control. The same fungus occurs very commonly on this scale in Montserrat. In this island the snow scale was a very serious pest in the dry year 1903, but has never assumed serious proportions since, except in isolated instances where trees were suffering from drought. This indicates that there also the black fungus is an efficient check on this scale. The white-headed and the shield scale fungi (*Ophionectria coccicola* and *Cephalosporium lecanii*) are equally effective, as far as present observations show; but as the first only occurs in Dominica, it is not possible to state how useful it would be under the drier conditions experienced in some of the other islands. Experiments will, however, be made to introduce it more generally, as it is almost the most vigorous of these fungi when under favourable conditions.

METHODS OF EMPLOYING THE FUNGI.

In some districts, where the general conditions are favourable to their growth, the parasites of certain species of insects exist naturally in large numbers. These parasites are responsible, under normal conditions, for the comparative rarity of these species in those districts. Such districts are usually spoken of as being unsuited to the species—a phrase which simply means that, in the battle between the host and the parasite, the natural conditions favour the parasite, and the numbers of the host are consequently kept at a minimum. Man's work in making use of these parasites is of two kinds: firstly, to introduce the parasite into districts in which the conditions are favourable to its growth, but in which it has not previously been known to occur; and secondly, to produce, where possible, by artificial means, conditions which are favourable to the parasites in districts where the conditions in general are not favourable. Some methods of achieving both of these objects will now be dealt with.

Three methods of introducing these fungi into fields where they have not previously been known to exist have been found to be successful in Florida, according to Dr. E. W. Berger of the State Experiment Station; but time has not yet permitted of any very definite observations on their effectiveness in the West Indies.

The first method consists of spraying the spores and portions of the mycelium of the fungi on to the trees which it is intended to infect. For this purpose, leaves well infected with the fungus should be stirred up for ten to fifteen minutes in water; there should be about forty fructifications of the fungus, or more, to each pint of water. The mixture should then be strained through a fine wire mesh, or a coarse muslin, and sprayed on to the trees. The author referred to above recommends that an iron sprayer or atomizer should be used for this purpose, or if the operation is to be conducted on a large scale, a compressed air sprayer with a galvanized iron receptacle. It seems, however, that if the liquid to be employed is carried in a galvanized iron bucket and not in a brass or copper receptacle, a brass syringe might be used with perfect

safety, provided it is emptied as soon as it has been filled and had not previously been employed for fungicides. The spray should be as fine as possible, as the trees should be sprinkled only, not soaked, any water that runs off representing a direct loss of spores. If the above precautions are carefully attended to, it is usually found that this method of artificial infection is the most successful of the three. The fungus material for mixing with water may also be taken from pure cultures; purely technical methods are required to obtain these, but when once obtained they could be kept constantly in stock in the Laboratory of this Department and distributed as required, thus enabling experiments to be carried on at those seasons of the year when fructifications of the fungi are not easily procurable in the field. When it is intended to infect only one or two trees for experimental purposes, it may be found that a large glass syringe with as fine a delivery nozzle as possible is a good instrument for spraying the trees.

This method may be employed for all the species of fungi found in the West Indies, with the exception of the black fungus (*Myriangium Duriæi*). whose spores are formed in such a way that they would not necessarily be liberated when portions of it are shaken with water. The second method, which is applicable to all the fungi, consists in tying infected material into trees which it is desired to infect. This should be done in such a manner that the fructifications of the fungi come into as close proximity to healthy scale insects as possible. This method, according to Dr. E. W. Berger, ranks second in order of efficiency in Florida, and should certainly yield successful results here.

The third method has not proved as successful as the other two, and has the additional disadvantage of being considerably more expensive in application. It consists in planting among the trees to be infected, small trees whose foliage is well infected with various parasitic scale fungi, so that the leaves of the small trees come into contact with those of the larger ones. If necessary such trees may be planted in pots or tubs and raised on platforms. This method has the disadvantage of not spreading the fungus as effectively over a wide area as in the other cases, and involves certain difficulties in watering in order to prevent the small trees from dropping their leaves.

The tying method is the one that commends itself as that most likely to be succesful here on account of the general conditions that prevail on estates; though spraying with spores will probably also prove useful, especially for a small number of trees.

In order to have a ready supply of these fungi always available, it is advisable, as far as possible, for every manager or planter, especially on lime estates, to be acquainted with some place where he can be certain of obtaining one or more of them. For this purpose, he should watch some particular tree known to be well infested, and when he notices that the scales are nearly all killed, should transfer the fungi to a neighbouring tree where there are scale insects in considerable numbers.

With regard to the artificial formation of conditions suitable to these fungi in localities where they are naturally unfavourable, there are two courses which may be followed. The main difficulties which have to be overcome are the effects of a bad drought, especially in the dry season, and those of wind.

In most of the islands, with the possible exception of Barbados and Antigua, the general conditions in the wet season are sufficiently favourable to permit of the fungi making good growth. Consequently, the only period when artificial help is necessary is during the dry season; it will probably be found that spraying one or two trees with clean water, once or twice a week, would enable the fungi to tide over the unfavourable conditions, and so afford a starting point from which they could spread again in the wet season. The other method, which is especially applicable in windy places, or in localities where the wet season is not usually sufficiently well marked to ensure the spread of the fungi, is to allow the trees attacked by scale insects to become covered with a fairly thick growth of Bengal beans (*Mucuna pruriens*, var.). This method is particularly applicable to lime trees. It has been definitely proved, in Montserrat, that the covering of beans helps to clear the trees of scale insects; evidence too, from other places, tends to support this, and to show that some fungi, at any rate, are more numerous in the damp sheltered conditions under the beans than is the case outside. It is possible that some other factor or factors due to the beans, which are as yet undetermined, also weaken the scale insect attack. It may be of interest to note in passing, that the Bengal beans encourage the presence of insect parasites of the scales as well as of the fungoid parasites as they afford shelter from the wind.

POSSIBLE RELATION BETWEEN HOST AND PARASITE.

When looking for parasitic fungi, with the possible exception of the black fungus (*Myriangium Duriœi*), it must be remembered that the fructifications, by which alone they are made easily visible, cannot be expected to be present in any given locality at all times of the year. They come and go according to the stage in its life-history that the fungus has reached at the time. As an illustration of this, the following observations in Dominica during 1909 may be cited. The fructifications of the red-headed fungus (*Sphærostilbe coccophila*) were observed at the Agricultural School in May, but had disappeared at the beginning of June; they did not re-appear until November. These facts should be considered in connection with the following observations made in Montserrat:—

One field was visited by Mr. H. A. Ballou, the Entomologist to this Department, and by the author on March 9, 1910. The field had suffered from attack by the purple scale (*Mytilaspis citricola*) during the preceding twelve months, and had been put under Bengal beans which had been cutlassed a month previously. The trees had recovered from the scale insect attack, but practically no red-headed fungus was observable, although it had been seen a month before in large quantities by two reliable observers. On the next field to leeward, however, fructifications of this fungus, both conidial and perithecial, were present in large numbers. The attack of the insects had reached this field somewhat later than the previous one, as the insects travelled with the wind, and consequently the fungus was still visible, as it also had started its life-cycle at a somewhat later date than in the first field. The presence of the perithecia, which probably constitutes the last stage in the life-history, would appear to indicate that the fungus was about to disappear from the second field also. Both of the instances just cited tend to show that the fungus has a definite life-period which must be influenced to some extent by the amount of food-supply available. It should also be borne in mind that the scale insects themselves have a definite life-period, though details with regard to this are at present wanting in the West Indies. It is probable that the season of greatest abundance of these insects falls between approximately the same dates each year, and the same would also be true of the season of least abundance. The sequence of events would appear to be somewhat as follows:—The spores of the fungus are blown on to a tree where numerous young scale insects are present; they germinate if the conditions are not too dry; the germ tubes penetrate the bodies of some of the young scales by growing in under the scale itself, and once established, the fungus spreads rapidly. After vigorous vegetative growth, during which the only sign of the existence of the fungus is the number of dead insects present, the food-supply becomes exhausted, and the fungus produces fructification and is then visible. Finally, the fructifications and most of the dead scales are washed off the tree by rain and disappear, leaving the tree clean with the exception of spores of the fungus caught in the bark, a small residue of dead scales that have not been removed, and a few healthy scales that have not been infected by the fungus. If the scale insects re-infect the tree, either owing to the increase of the original survivors, or to infection from an outside source the spores germinate again, or re-infection takes place from outside, and as the scales become fairly numerous, the life-story of host and parasite is repeated. There are thus probably two periods when the fungus is not visible: one when it is making much vegetative growth, scale insects being numerous, the other when it has disappeared owing to the absence of a sufficient food-supply; under the latter circumstance, very little fungus is present at all on the tree. How far the life-period of the fungus is affected by external conditions remains to be seen; probably moisture has an effect on the rate of growth during the period of vegetative activity. The relationship of the fungus life-period to that of the host also requires investigation, but for this, the life-period of the scale insects, that is the time occupied from one brood to the next, must first be carefully determined. In any case, it seems that the food-supply, as afforded by the insects, cannot be expected to be entirely continuous. Green, in his book on the *Coccidœ of Ceylon*, remarks on the periodicity of the appearance of the green shield scale (*Lecanium viride*), and says that this is apparently connected with weather conditions, extremes of rain or of drought being alike unfavourable. Moreover, when the numbers of live scales are decreasing, the shield scale fungus is always found to be present and may kill as many as 90 per cent. of these insects.

The above suggestions are put forward in a purely tentative manner, as the evidence on which they are based is insufficient to permit of any

definite conclusions. They may, however, be useful as suggesting lines of work for future investigation. The matter is one of some importance locally, as fructifications are often wanted for purposes of spreading the fungus, and, as has been noted, they cannot always be found. When this is due to the greater vegetative activity of the fungus, it might be spread with equal effect by using branches of trees on which fructifications of the fungus had formerly been observed, but from which they had subsequently disappeared. The mycelium of the fungus would then be present. But when the absence of the fructification is due to the disappearance of the fungus owing to want of food, such material would be nearly useless for infection purposes. In this case the scale insects themselves would probably be far from numerous, and those present would be mainly dead, unless the tree had been reinfected with insects while the fungus had not had time to obtain a hold.

EFFECTS OF CLIMATE.

The general climatic factors which may have an influence on the effectiveness of these fungi are three, namely, Temperature, Wind and Moisture.

Temperature.—The four species of fungi known in the West Indies all belong naturally to the tropical or subtropical regions, and consequently cannot be expected to flourish in colder parts of the world. This expectation has been fully borne out in the case of the red-headed fungus (*Sphærostilbe coccophila*). Several attempts have been made to introduce it into the more northern of the United States and into Canada, but it has never been sufficiently vigorous under the colder conditions to be of any economic importance in controlling insect pests.

Wind.—Parasitic fungi are never so effective in windy situations as in sheltered ones. In fact, they are rarely found in places where they are exposed to any severe winds. This is probably mainly due to the drying effects of the wind. The shield scale fungus (*Cephalosporium lecanii*) has been found by Mrs. Patterson in St. Vincent attacking the mango shield scale (*Lecanium mangiferæ*), which was growing on a tree in a very windy place, but the fungus was not of luxuriant growth and did not appear to be nearly as effective as it is in calmer places.

Moisture.—This is the most important factor influencing the growth of these fungi—a fact which is clearly illustrated by the relative effectiveness of the fungi in the different islands. The parasites are very plentiful in Dominica, where the rainfall varies on some estates from 100 to 150 inches in a year, and in St. Lucia, where there is almost as heavy a rainfall, at any rate in some districts. As already stated, since the year 1903, there has not been a single outbreak of scale insects of any really serious dimensions in Dominica. Dr. E. W. Berger remarks that under natural conditions, fungi were able to control the attacks of white fly once every three years. It would seem, however, that in Dominica the scale insects are kept in check much more effectively than this. On the other hand, in Antigua and Barbados, and possibly even St. Vincent, they are not nearly as effective. In the former case this is probably owing to drought; in the latter, the causes would appear to be more complicated, as the island is not excessively deficient in rainfall. In fact, at one time citrus trees could be grown there with success, though now, more especially since the eruption in 1902, they are persistently destroyed by the attacks of scale insects. The actual reasons for this require further investigation, as at least three species of parasitic fungi are known to be present on scale insects in the island.

A good instance of the effect of drought is furnished by the outbreak of scale insects in Montserrat and Dominica already referred to, which took place in 1903. It was found that while both the white and purple scales (*Chionaspis citri* and *Mytilaspis citricola*) were present in both islands, the greater part of the damage in Montserrat was due to the white scale (*Chionaspis citri*), while in Dominica, which even in a dry season is damper, the purple scale (*Mytilaspis citricola*) was more serious. It has since been found that under normal conditions the black fungus (*Myriangium Duræi*) acts as an efficient check on the white scale in both islands, while observations show that in Montserrat this scale never becomes serious unless the tree is suffering from drought. This would appear to indicate that, in 1903, the drought in Montserrat was so severe as to check the black fungus and thus enable the white scale to become numerous. In Dominica the drought was not so severe as completely to check this fungus, though the more delicate red and white-headed fungus parasites of the purple scale (*Sphærostilbe coccophila* and *Ophionectria coccicola*) were rendered ineffective. These observations would appear, then, to bring out two points. Firstly, the effect

of drought on the fungi, as already indicated; and secondly, the fact that the black fungus is hardier in this respect than the other species. The second of these conclusions, however, must be tested by future observations before it can be definitely accepted, as there are no records of the relative abundance of the fungus in these two islands during the year under consideration.

The outbreak of scale insects in Dominica in 1903 presents some further features of interest in connexion with the effect of external conditions on the parasites of these insects. In 1902 the season was dry, the yield of fruit from the lime trees, which were those principally attacked, was very heavy, and the island was covered with dust from the eruption of Mont Pelee. During the ensuing dry season at the beginning of 1903 the trees were badly attacked by scale insects, which, however, rapidly disappeared again in the subsequent normal years 1904 and 1905. It is of course clear that the trees had been weakened by the heavy crops, combined with the general unfavourable conditions in 1902; but it is also fairly certain that the spread of the scale insects was largely due either to the absence of the parasites by which they had formerly been controlled, or at any rate to the check that the parasites had received through want of moisture, together with the effects of the volcanic ash, in 1002, and the succeeding dry season in 1903.

The idea that the reduction of the parasites was the factor mainly responsible for the outbreak of this scale insect attack is supported by the gradual return to the normal conditions which occurred during the years 1904 and 1905, and by the absence of any serious subsequent attacks. Moreover, the outbreaks cannot be explained as due to the introduction of new species of scale insects, as the scales concerned, mainly the purple and the white scales (*Mytilaspis citricola* and *Chionaspis citri*) were both reported by Professor Riley as being present in the island in 1894. It should also be mentioned that on some estates extensive spraying operations were carried on chiefly with kerosene emulsion and rosin compound. The trees of such estates recovered much more quickly than those which were not treated, and it seems likely that in certain cases, at any rate, the complete loss of any trees was prevented. It should be noted, further, that the solutions used were those least likely to have any harmful effect on parasitic fungi of the scales, and that they probably were of actual assistance by checking those insects sufficiently to enable the parasites to regain their former supremacy.

As the effect of volcanic ash has been mentioned, it may be worthy of record that there seems to be a fairly general belief among planters throughout the islands, to the effect that black blight, and therefore probably scale insects, have been more common since the big eruptions in Martinique and St. Vincent in 1902. This may possibly be due to the effect of the ash on the parasites of the scales. While it might be so in the case of the delicate insect parasites, it is not an easy matter to account for the effect on the fungi. In any case this would seem to be an illustration of the great increase in numbers of an insect, owing to the fact that the natural control exerted by its parasites had been removed, or seriously checked. The scale insects may themselves have been greatly reduced in numbers, but the much larger destruction of the more fragile parasites provided an opportunity for their almost unrestrained natural increase. As there is little doubt that the survival of the parasites occurred to some extent, it is fairly certain that they will ultimately reach such numbers as to be capable of exerting the same control as existed before the volcanic eruptions.

THE EFFECT OF SCALE INSECT PARASITES ON THE PRESENCE OF BLACK BLIGHT.

As a result of enquiries made in all the islands, it has been shown fairly definitely, that black blight fungi (*Capnodium* and *Meliola* sp.), but especially *Capnodium mangiferæ*, are never found on trees where they are not in some way or other associated with the presence of one or more species of scale insects. The commonest insects in this connection are the green scale (*Lecanium viride*), and the mango shield scale (*L. Mangiferæ*). Consequently, the reduction of the scale insects by means of their parasites should be attended by a lessening of the amount of black blight, and where a tree is successfully cleared of insects, the blight should also disappear. Experiments with a view to controlling black blight in this way have been suggested for trial in Grenada, an island in which there is a very large amount of this disease. On the other hand, the author has seen a species of black blight fungus on a palm at the Botanic Station at St. Lucia, distributed in such a way under the inflorescences as to lead to the suspicion

that the fungus was living on the nectar falling upon the leaves from the flowers. This idea was supported by the fact that there were very few scale insects present on the leaves. Mr. Moore, the Agricultural Superintendent in St. Lucia, who first observed this suggested that possibly the same thing was true in the case of the mango, and if so, removal of the scale insects would not have the effect of removing the blight until after the flowering season in the case of the trees mentioned. These points, however, all require further investigation, and at any rate, the question of the prevention of black blight is somewhat of a side issue.

COMPARISON OF ARTIFICIAL AND NATURAL METHODS OF CONTROLLING SCALE INSECTS.

Before proceeding to the next division of the subject, it may be advisable to add that Hume in his book on *Citrus Fruits and their Culture*, rémarks that the effect of attempting to combine the artificial control of scale insects (by means of various sprays and by fumigation) with the natural control (by means of parasites), only results in producing the bad effects of both methods; and it seems at present that the natural means of control is undoubtedly the one most suited to the conditions in the majority of the West Indian Islands. The reasons for this are of two kinds. In the first place, the natural method of control is not so expensive to institute as the artificial method, involving as it does no outlay on spraying pumps and materials, and but comparatively little labour. Further, it does not necessitate periodically recurring outlays for the repetition of the treatment, since once established, the only cost involved, that of reintroducing the parasites where this is necessary by means of one of the methods already described, and of replanting Bengal beans (*Mucuna pruriens*, var.) in places where their use is advisable, is of very minor importance when compared with the expense incurred in extensive spraying operations, which may have to be repeated two or three times in a year. In the case of limes, moreover, the value of the crop is small compared with that of the more specialized forms of citrus fruits, such as oranges, so that it does not permit expensive spraying operations to be conducted with profit. Cost is an even more important factor in the case of field fumigation on account of the heavy outlay involved in buying tents. Secondly, on many estates in the West Indies, the nature of the ground, its roughness and slope, difficulties of obtaining water, of procuring sufficiently skilled labour, and similar factors render spraying on a large scale impossible from a practical point of view. These same factors, more especially that of obtaining sufficiently skilled labour, also prevent, to an even greater extent, the use of fumigation.

Experience in Montserrat, where the scale insects are always liable to cause serious trouble, has shown that with a little assistance, more especially in dry seasons, the natural enemies are just able to keep the insects in check. Recent investigations by the Entomologist of the Department, Mr. H. A. Ballou, and by the author have shown that numerous parasitic species of both insects and fungi are present, and possibly the control effect is due more to the number of species than to the number of individuals of those species. Mr. Driver and his colleagues are of the opinion that spraying methods are not of much use; and moreover, trees examined showed clearly that where sprays had been employed, the natural enemies of the scales had received a decided check. This was well illustrated in one particular case. In a certain field a belt of trees had been sprayed about twelve months before they were examined, while the remainder were left unsprayed. On the unsprayed portion the red-headed fungus (*Sphærostilbe coccophila*) was abundant on the white and purple scales (*Chionaspis citri* and *Mytilaspis citricola*,), but on the sprayed portion only a few fructifications were found. This observation certainly supports the statement by Hume referred to above.

The following is a short abstract of a letter written by Mr. P. Foster Huggins to the St. Vincent *Sentry* of April 8, 1910, that contains some points of interest in this connection :—

The frequent appearance of black blight in St. Vincent is associated with scale insects which infest either the plants which exhibit the blight or overhanging trees. The author found that individual effort to control the scales by artificial means was useless, as, even when the trees were cleared, they rapidly became reinfested from surrounding vegetation on which the scales abounded. He lost hundreds of grown orange and other trees owing to the prevalence of the scales, but recently some of the remaining trees have shown signs of improvement. This has been due to the presence of a small red fungus on the scales (undoubtedly *Sphærostilbe coccophila*), which attacked the mussel scale (*Mytilaspis citricola*), the white

scale (*Chionaspis citri*), and the red scale (*Aspidiotus sp.*), though the star scale (*Vinsonia stellifera*) was unaffected. Experiments in transferring the fungus from tree to tree were successful whenever the weather was wet, and the author now has hopes, not only of keeping his trees alive, but of getting them into a good condition for cropping.

On the other hand, under exceptional circumstances, such as a serious epidemic of scale insects in a dry season, it is probable that the judicious use of insecticides such as whale-oil soap compound, kerosene emulsion, or rosin compound would prove of the utmost value. Not only would such spraying mixtures prevent the immediate infliction of excessive damage on the trees, but they would as already pointed out, enable the natural enemies to regain their position in a shorter time. Dr. Berger in a short article 'Citrus Scales and Whitefly' contained in the *Florida Agriculturist* for March, 1910, supports this view, but insists on the avoidance for this purpose of any insecticides containing sulphur or possessing any fungicidal ingredients.

When considering this point it must, however, be borne in mind that, in addition to the four species of fungi, there are also several species of insects which live on scale insects. Among these is a small hymenopterous species which lives as an internal parasite on the purple scale (*Mytilaspis citricola*). Such delicate insects, and especially that just referred to would almost certainly be destroyed by insecticides, and the proportion of them thus killed would be even greater than that of their hosts. Thus it would probably be found after employing insecticides, that parasitism by these insects would not be as common as before. As a result of these arguments it will be evident that, even in serious cases, insecticides should only be used as a last resource, once it has been determined that the natural means of control is that most suited to ordinary conditions.

SUMMARY.

(1) Four species of fungoid parasites occur on scale insects in the Lesser Antilles, namely: *Cephalosperium lecanii*, *Myriangium Duriæi*, *Ophionectria coccicola*, *Sphærostilbe coccophila*.

(2) These may artificially spread either by the spore-spraying method, or the tying-in method.

(3) The fungi are most effective in the islands of Dominica and Montserrat upon the scale insects attacking limes, but are also of general importance in all the islands.

(4) The use of Bengal beans as a cover to trees, more especially lime trees, serves to protect them from attacks of scale insects, probably by encouraging the natural enemies.

(5) The factors which affect the usefulness of these fungi are temperature, wind and moisture; of these the last two are the most important locally.

(6) The natural means of controlling scale insects is that most suited to circumstances here, both owing to the general conditions and to the much smaller expense involved. Under the exceptional circumstances of an epidemic, the use of non-fungicidal sprays may be found advisable.

In conclusion, the thanks of the Department and of the writer are due to Professor H. S. Fawcett, M.A., of the Florida State Experiment Station, for much valuable assistance and information; to Dr. H. T. Fernald, Ph.D., of the Agricultural Experimental Station, Massachusetts, Mr. J. H. Hart, F.L.S., of Trinidad, and Mr. R. H. Compton, B.A., of Gonville and Caius College, Cambridge, for assistance in obtaining publications, and in other ways.

SCIENTIFIC AGRICULTURE.

THE EFFECT OF THE SUN IN THE TROPICS ON ANIMALS AND MAN.

BY HANS ARON,
Professor of Physiology in the
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(*Berlin klin. Woch.*, June 9, 1911.)

(From the *Veterinary News*, No. 403, Vol. VIII., September 23, 1911.)

The rays emitted by the sun may be divided into three groups: (*a*) The ultra-red or heat rays; (*b*) the visible or light rays; (*c*) the ultra-violet or actinic rays. Freer, Bacon, and Gibbs have investigated the solar spectrum in Manila, and find that its range on the ultra-violet side is not greater than in Northern regions, but its chemical activity in July as gauged by its action on oxalic acid and uranyl nitrate is from five to twenty times greater than in Chicago.

Many observers have ascribed the peculiar effects of the tropical sun to the action of the actinic and light rays on the human body. The negative results of the experiments on the American troops in Manila with orange-red coloured clothing as well as numerous observations made in the Tropics by Aron have convinced him that the actinic theory cannot be maintained.

In order to determine the effect of the sun's heat rays in Manila, Aron made a number of experiments, some of which are quoted below.

One thermometer was placed in the rectum of a dead dog, and another under its skin, and the body suspended in the sun. The thermometer placed under the skin very soon registered a temperature of 46°C., while the one in the rectum showed a gradual rise due to absorption of heat. A living body absorbs heat in the same way, but a rise in the body temperature is prevented by the physiological mechanism for increasing the loss of heat.

A dog kept exposed to tropical sunshine soon suffers from acute discomfort, and its rectal temperature is found to rise from 38°C. to 39°C.; a thermometer placed under its skin, however, shows a rise to 40°C. or higher. Rabbits placed under similar conditions show a greater rise of temperature, the thermometer placed under the skin recording as much as 46°C., but when these temperatures are reached the animals soon die.

The most instructive experiments were those conducted on monkeys (*Macacus philip.*, Geoff.). When a strong and healthy monkey is placed, so that it is continuously exposed to the sunshine, its temperature rapidly rises, and seventy to eighty minutes' exposure, even between 8 and 9 a.m. in December or January, is sufficient to kill it. If protected from the direct rays of the sun it can be kept in the same place for any length of time without suffering any injury.

Normally the rectal temperature of the monkey is 0·5° to 1°C. higher than its subcutaneous temperature. When exposed to the sun's rays the body temperature rapidly rises, but the subcutaneous temperature is always 1° to 2°C. above that of the rectum. The immediate effect of shaving a monkey is to reduce its temperature generally, but the effect is more marked on the subcutaneous temperature. When shaved monkeys were exposed to direct rays of the sun, the rise in temperature and subsequent death took place more rapidly than in similar animals whose hair had not been removed.

That the animals exposed to the sun's rays died as a direct result of hyperpyrexia is shown by the following experiments. Monkeys were exposed to the sun's rays as in the previous experiments, but by means of fans a strong current of air was directed on to the animal's body. In spite of several hours' exposure under these conditions the rise in body temperature was only slight, and the animals remained healthy. A control animal exposed within a few yards of the first one, but not artificially cooled, died of hyperpyrexia in fifty-eight minutes.

In another experiment the body of a monkey was placed in a wooden box with perforated walls, which was again placed inside a larger one, leaving an air space between the two, so that its head was exposed to the sun's rays, but its body was thoroughly protected by the ventilated air space and walls of the boxes. The monkey was kept in this position and exposed to the sun's rays from early morning till night without any rise of body temperature taking place, or any signs of interference with its health. The same animal was exposed under similar conditions to direct sun's rays for altogether fifty-four hours within a period of twelve days, and apparently suffered no damage. During this period

temperatures taken in the hair on the animal's head were frequently found to register as high as 47°C.

Some observations were then made as to the effect of sun's rays on the human skin. White and dark brown skins were selected and their normal temperature carefully determined; this varied between 32·5°C. and 33·5°C. There was no constant difference between the two colours. When exposed to the sun the skin temperatures rapidly rose to 36·5°C. or 37°C.; on continuing the exposure there was no further rise of temperature, but on the contrary a gradual fall of 0·5°C. to 1°C. was observed. The fall usually began with the appearance of diaphoresis. The fall was more rapid and greater when active exercise was being taken, and there was copious perspiration. If the man had been working hard and perspiring freely before being exposed to the sun's rays there was only a slight rise of the skin temperature. Dark skins did not, so far as the experiment went, show quite so much rise of temperature as white ones. A possible explanation may be that the dark skin absorbs more heat rays at first, but in consequence the sweat glands come into action sooner, and so prevent the temperature from rising as high as in the case of white skins.

Although the effect of the sun's heat on the human body is neutralized by physiological action, this makes certain demands on the human organism. This is shown by one set of observations, in which persons lightly clad were kept at rest but exposed to the sun's rays; the result of this exposure was to increase the pulse-rate by 8 to 12 beats, and the volume of respiration by 23 per cent. Under similar conditions a Philippine weighing 57 kg. lost weight to the extent of 280 grm. in one hour, although no allowance was made for the perspiration absorbed by his clothes.

When active exercise is being taken the heat produced by muscular action added to that absorbed from the sun's rays may produce a condition of collapse.

AGRICULTURAL EDUCATION.

FARMERS' CO-OPERATIVE DEMONSTRATION WORK IN ITS RELATION TO RURAL IMPROVEMENT.

BY S. A. KNAPP,

Special Agent in Charge of Farmers' Co operative Demonstration Work.

INTRODUCTION.

The aim of the Farmers' Co-operative Demonstration Work is to place a practical object lesson before the farm masses, illustrating the best and most profitable methods of producing the standard farm crops, and to secure such active participation in the demonstrations as to prove that the average farmer can produce better results.

This work also shows that there is no necessity for the general deterioration of farms and the too common poverty of the rural masses. When these facts have been demonstrated, the first step in the improvement of rural conditions has been taken.

THE NECESSITY FOR IMPROVED RURAL CONDITIONS IN THE SOUTH.

Every substantial advance in the progress of human society costs money and must be maintained by an increased earning capacity of the masses. Food and clothing are the first requirements. If the earning capacity of a people is only sufficient to supply these, progress is blocked and it is useless to insist upon better houses, more home comforts, schools, or any upward step. The problem is, Are the rural masses unwilling to provide the betterments which a progressive civilization in the country demands—comfortable houses with improved home and farm equipment, good schools and more months of schooling, better highways, rural free delivery, telephones, etc.—or do they lack the means?

Upon the answer depends the proper remedy for existing conditions. If unable, steps should be taken to increase the earning capacity of the rural toilers; if able, but unwilling, the rural pride should be aroused and the force of public opinion, and even law, brought to bear. Nearly every man, even among the poorest, will clothe his family better, improve his home, and add conveniences if he earns more. In the course of social investigations in rural districts for many years the writer noticed that invariably better clothing and more comfortable homes result from increased earnings. Go into a thousand villages in the South and ask the merchants if the poorest coloured men would buy better clothes if they had the money. The answer is: "They will buy everything

in sightclothing, watches, buggies, etc." Their expenditure may not be judicious, but it shows a desire to spend money to increase their comforts. Experience will correct the errors.

The farmer is necessarily conservative, but offer him a genuine thing and prove it and no one is more responsive. He will not accept what has not been fully tested, and he must see it to believe, because he has been frequently deceived. He wants all that the best civilization can give him if he can get it. Increase the net income of the average farmer and the wages of the rural toiler, and the first step necessary to the uplift of the rural masses will have been taken. The following results will be brought about as rapidly as time will permit:

(1) The emancipation of the farmer from the bondage of debt.
(2) The ownership of more and better tools, teams, and stock on the farm.
(3) The improvement of the land.
(4) Better rural school buildings and more months of schooling.
(5) Better highways, rural-mail delivery, and telephone service.
(6) Contentment with the life of a farmer,

In the Southern States, in every township and in nearly every neighbourhood, there are a few who are able to support a better civilization than the one in which they live. Finding that it is difficult to obtain what they require they move to a town or city. Such removal to secure better social, religious, or educational advantages are matters of common occurrence. But, after all, this class forms the minority, and it is the condition of the great majority which must be considered.

Most people agree that rural conditions should be improved. The farmer believes it as strongly as anyone. The problem is to know where to begin. Shall we trust the people and commence by increasing their resources, or shall our efforts be directed to improving farm dwellings and home conditions, the construction of better highways, or the introduction of the telephone, the rural free delivery of mails, the community library, and improved social and religious privileges?

Evidently the answer depends upon the degree of advancement of rural communities. The remedy that would help one might be utterly inapplicable to another. For example, if it were found that the average farmer in a rural township lived in a house valued at about $100, without any barn or garden (not a mere patch of green, but a well-tilled plot that furnished in the South sufficient tubers, roots, legumes, melons, and fruit in their season for the family) and without a cow, a pasture, and a sufficient supply of poultry, and if it were also found that a majority of the tillers of the soil were unable to read and were heavily involved in debt, it would be the height of folly to commence the rural uplift by establishing a public library or even a school. The rural toilers must first be properly nourished, clothed, and housed; it is the order of greatest necessity. The money to do this cannot be given to them, and if it were there would be no uplift. They must be shown how to earn it by a better tillage of the soil and how to husband their earnings by greater thrift. Low wages, a small amount of work accomplished in a day, and an uneconomic use of resources are features of any civilization marked by a low earning capacity.

No mistake is made more frequently than to assume that low wages are a result of oppression. As a rule, the wages are determined by the accomplishment. In India it requires from fourteen to twenty-four servants to do the work of a small household, where an in some portions of the United States two would do it better.

Upon a farm one man in the United States with a good team and modern machinery can do the work that fifty to one hundred men do in many oriental countries. Consequently, when the latter are paid 5 to 10 cents a day they are paid up to their earning capacity, a capacity that is insufficient to sustain a high civilization.

As a preliminary step, then, in this inquiry, let us determine the present status of the rural South with respect to the following items:—

(1) The earning capacity of the average farm worker in the South.
(2) The average number of acres in each State worked by one man.
(3) The character and value of the buildings.
(4) The value of implements and tools on the average farm in each State.
(5) The number of horses or mules used for each farm labourer.
(6) The average number of milch cows on each farm.
(7) The average value of poultry on each farm.
(8) The percentage of farms in each State worked by tenants.

The following tables present these facts in compact form for the various parts of the United States:—

Table I.

Farm Conditions in North Atlantic Division of the United States.

State.	Annual income of each farm worker.	Number of acres worked by one man.	Value of buildings on each farm.	Value of implements and machinery on each farm.	Number of horses to each farm labourer.	Number of milch cows to each farm.	Value of poultry on each farm.	Percentage of farms worked by tenants in each State.
	$		$	$			$	
Connecticut ...	357·78	24	1,469·55	139·98	1·2	6	28	12·9
Maine ...	266·50	29	655·08	109·51	1·425	3·5	15·8	4·7
Massachusetts ...	404·49	19	1,629·29	180·37	1·15	6·5	33·3	9·6
New Hampshire ...	301·21	28	983·62	136·90	1·467	5·1	20	7·5
New Jersey ...	356·09	28	1,528·11	186·81	1·45	5·8	42	29·9
New York ...	296·25	41	1,139·48	180·53	1·7	7·6	2·4	23·9
Pennsylvania ...	261·15	39	1,173·34	166·98	1·9	4·7	21·3	26
Rhode Island ...	363·69	17	1,637·13	205·06	1	5·8	6·3	20·1
Vermont ...	327·37	43	877·87	170·61	1·75	9·2	14·7	14·5

Table II.

Farm Conditions in North Central Division of the United States.

Illinois ...	425·13	60	754·49	134·20	3·2	4·35	26	39·3
Iowa ...	611·11	80	818·87	196·55	3·9	6·8	30·5	34·9
Indiana ...	316·70	48	454·86	78·99	2·4	2·967	20·2	28·6
Kansas ...	461·40	92	489·32	122·12	4·06	4·5	28	35·2
Michigan ...	239·64	38	571·69	108·26	1·95	3·2	14·5	15·9
Minnesota ...	465·35	72	512·10	141·11	2·8	5·4	16	17·3
Missouri ...	269·47	49	401·05	80·45	2·713	3·2	21·5	30·5
Nebraska ...	554·78	98	586·01	164·11	4·567	4·8	21·8	36·9
North Dakota ...	755·62	134	426·00	238·84	5·125	3·6	13	8·5
Ohio ...	312·58	46	602·88	97·60	2·133	3·3	19·8	27·4
South Dakota ...	605·69	136	412·03	203·14	5·9	6·1	20	21·8
Wisconsin ...	349·49	42	683·24	122·77	2·125	6·4	15·4	13·5

Table III.

Farm Conditions in South Central Division of the United States.

Alabama ...	143·98	16	95·56	23·40	0 675	1·8	7·36	57·7
Arkansas ...	169·60	20	114·13	32·25	1·25	2·47	9·18	45·4
Indian Territory...	292·94	33	102·35	54·50	3	3·5	12·45	74·9
Kentucky ...	192·57	33	214·05	38·22	1·6	1·9	12·8	32·8
Louisiana ...	216·47	16	130·10	21·23	1·16	2·85	11·8	58
Mississippi ...	168·33	15	102·43	26 51	·9	2·1	8·8	62·4
Oklahoma ...	458·93	58	184·45	88·17	3·8	3·5	15·8	21
Tennessee ...	170·91	24	131·64	42·85	1·5	1·8	11	40·6
Texas ...	305·63	30	172·66	52·01	2·8	3·3	11·8	49·7

Table IV.

Farm Conditions in South Atlantic Division of the United States.

Delaware ...	236·07	39	940·56	178·86	1·8¼	4·3	38·4	50·3
District of Columbia ...	...	4	6,493·62	503·47	...	...	...	43.1
Florida ...	119·72	17	175·87	30·43	·6¾	3·7	11·2	26·5
Georgia ...	158·69	20	115·58	24·93	·6½	1·9	7·5	59·9
Maryland ...	243·85	37	800·16	112·08	1·7½	4·	27·4	33·6
North Carolina ...	146·75	18	134·25	23·24	6½	1·6	7·3	41·4
South Carolina ...	144·46	14	101·17	23·54	·5	1·5	6·7	61·1
Virginia ...	191·05	33	219·11	29·81	1·1½	1·2	12·2	30·7
West Virginia ...	180·00	30	239·25	33·94	1·3	2·5	11·3	21·8

It will be noted that the average value of farm buildings and farm machinery for each farm as given in these tables for each State differs from that given by the census of 1900. The explanation is that in the census enumerations the value of the buildings on a single farm, whether large or small, is given in one sum, and does not therefore tell how the labourer is housed, for in this sum may be included the value of 40 or 50 houses, as is generally the case on very large farms, especially in the South. The same rule applies to implements. For our purpose the average of buildings and implements on the smaller farms was taken, so as to determine how one family lives and what implements it uses; but in every State enough farms were included in the estimates to make a majority of the farms of that State.

It should be borne in mind that these tables represent conditions in 1900. Since that time rural prosperity has been greater than in any former period of American history. Undoubtedly the next census will show marked improvements.

Tables I to IV show the value of the buildings on each farm worked by one family; the value of the implements and farm machinery; the value of the poultry and the average number of cows to the farm; the number of horses (or mules) for each labourer; the number of acres each labourer tills and the amount he produces annually in value, and the percentage of farms worked by tenants in each State. These tables show the condition of the housing of families and stock in the Southern States, the farm equipment provided to do the work, the amount of work accomplished, and the annual earnings, which fully accounts for the condition of schools, roads, and churches in the country. The average income is scarcely sufficient to maintain the civilization now existing, ignoring progress, and these facts do not present the whole truth of the situation.

Quite a percentage of the small farmers still owe on their farms. Prior to 1905 the percentage of these in some States amounted to three-fourths of the whole; since that date there has been considerable decrease.

Nearly all the tenant farmers of the South and a large proportion of the farm owners have been working their lands by securing annually advances from the merchants, thus paying from 20 to 75 per cent. more for their supplies than under a cash system. This situation is rapidly improving.

SOME REFORMS NEEDED IN RURAL LIFE.

For the improvement of rural life many things are needed :—

(1.) The improvement of country schools, or, rather, the establishing of real schools for the country. Many leading educators believe that the country school has yet to be conceived and established. It has been said with great force that "the existing country schools are but poorly equipped city schools located in the country."

(2.) County or district agricultural schools, in which the main work shall be to impart knowledge that tends to make the successful farmer and the good citizen, and to give a training to youth adapted to rural life, in sympathy with toil and in love with the farm.

Several States have taken the initiative in establishing such schools. It is believed by their friends, and hoped by all that they may lead to a solution of the problem of the best education for rural life.

(3.) It is also desirable that text-books in country schools shall have for illustrative material incidents and experiences drawn mainly from rural life instead of from commerce, politics, diplomacy, and war.

(4.) It will doubtless be found advantageous at times to co-operate in buying and selling, in borrowing money, etc.

(5.) The proper valuation of property as a basis of taxation to establish and maintain rural betterments should be considered.

All the improvements required in rural life we see and realize. The purpose of this publication, however, is to call attention to a reform which is fundamental to all these things, and which must necessarily precede them, logically and chronologically.

THE REMEDY OFFERED BY THE FARMERS' CO-OPERATIVE DEMONSTRATION WORK.

What primary remedy for the improvement of rural conditions ought a republic to propose where all the adult male citizens are expected to exercise through the ballot the functions of a ruler? Evidently it should be one that can directly and immediately benefit all the people. More than nine-tenths of the rural population of the South are limited by their conditions to an education provided by the country district school. What help can be given them that will be immediate and will benefit both parents and children? It must be such that it will reach the farm and

appeal to the interests of the farmer. It must find the man and not compel the man to find it. It must be a home remedy.

The only remedy that can be successfully applied to help all the rural people, one that will be effective and immediate, is to increase the net earnings of farmers and farm labourers. The paramount issue now is how most wisely and effectively to aid all the rural people. If each farmer is shown how to produce twice as much to the acre as he now produces and at less cost, it will be a profit in which all rural classes will share, and will be the basis of the greatest reform ever known to rural life.

How can the knowledge of better agricultural methods be conveyed to the masses in a way so effective that the methods will be accepted and their practice become common? For many years the United States Department of Agriculture, the agricultural colleges, experiment stations, the agricultural press, the farmers' institutes, and the National and State bulletins upon agriculture have thrown light upon almost every topic relating to the farm. These have been of great assistance to farmers who are alert and progressive, but the masses, especially in the South, have scarcely been affected. There came a time under cotton-boll weevil conditions when it was found necessary to reach and influence the poorer class. The co-operative demonstration plan was then tested.

The Farmers' Co-operative Demonstration Work aims at several things:—

(1) To reform agriculture and make it an occupation of profit and pleasure.

(2) To improve rural conditions.

(3) To broaden and enrich rural life.

(4) To make the farm attractive and country residence desirable.

ORGANIZATION OF THIS SPECIAL WORK.

As organized under the Bureau of Plant Industry the working forces of the Farmers' Co-operative Demonstration Work consist now of one Director with assistants, 16 State agents, and 188 district and local agents. Local agents must be practical farmers and thoroughly instructed in their duties by the State and district agents. Semi-annually State meetings of agents are called for instruction, at which the director or an assistant from Washington is present. Weekly reports showing work accomplished each day are made by all agents to the director.

The campaigns for the ensuing year are planned in September, and active work commences in October by calling public meetings in every district to be worked, at which is shown the great advantage to all the people of increasing the crop yield two, three or four fold, and it is made clear that this can be done by adopting better methods. In country villages the banker, the merchant, and the editor join with the leading farmers of the section in indorsing the progressive plans of the demonstration work; farmers agree to follow instructions, and demonstration plots of one or more acres are located so as to place a sample of the best farming in each neighbourhood of a county or district. There must be enough of these to allow every farmer to see one or more during the crop-growing period. The necessary work on the plot must be done by the farmer and not by a Government agent, because the whole object lesson is thereby brought closer to the people. The demonstrating farmer understands it better because he does the work, and his neighbours believe that what he has done they can do.

INSTRUCTION OF THE FARMER.

Each month during the season instructions are sent to every demonstrator and co-operator, clearly outlining the plan for managing the crop. In addition, a local agent is expected to call on each demonstrating farmer monthly and explain anything not understood in the instructions.

FIELD SCHOOLS.

Previous notice by letter is given to all the co-operating farmers (such as are instructed in the work and agree to follow instructions) in a neighbourhood to meet the agent on a certain date at a given demonstration farm, where the crop and plans are thoroughly discussed. This is called a "field school," and has been marvellously effective in arousing local interest. At such meetings and on all occasions where the agents meet farmers, the following fundamental requirements for good farming are discussed by the aid of notes sent out from the central office.

(1) Prepare a deep and thoroughly pulverized seed bed, well drained; break in the fall to the depth of 8, 10, or 12 inches, according to the soils, with implements that will not bring too much of the subsoil to the surface. The foregoing depths should be reached gradually.

(2) Use seed of the best variety, intelligently selected and carefully stored.

(3) In cultivated crops give the rows and the plants in the rows a space suited to the plant, the soil, and the climate.

(4) Use intensive tillage during the growing period of the crops.

(5) Secure a high content of humus in the soil by the use of legumes, barnyard manure, farm, refuse, and commercial fertilizers.

(6) Carry out a systematic crop rotation with a winter cover crop.

(7) Accomplish more work in a day by using more horsepower and better implements.

(8) Increase the farm stock to the extent of utilizing all the waste products and idle lands of the farm.

(9) Produce all the food required for the men and animals on the farm.

(10) Keep an account of each farm product, in order to know from which the gain or loss arises.

In the course of these discussions it has often developed that the majority of small farmers had never fully complied with any of these rules. They thought they knew all about farming, and charged their small product and failures to the seasons or the land. One farmer at a public meeting in Alabama this year expressed his views as follows :—"I was born in a cotton field and have worked cotton on my farm for more than forty years. I thought no one could tell me anything about raising cotton. I had usually raised one-half a bale on my thin soil, and I thought that was all the cotton there was in it in one season. The demonstration agent came along and wanted me to try his plan on two acres. Not to be contrary, I agreed, but I did not believe what he told me. However, I tried my best to do as he said, and at the end of the year I had a bale and a half to the acre on the two acres worked his way, and a little over a third of a bale on the land worked my way. You could have knocked me down with a feather. This year I have a bale and a half to the acre on my whole farm. If you do not believe it, I invite you to go down and see. Yes, sir; as a good cotton planter I am just one year old."

These field schools are bringing about a revolution. A meeting of a township called at a home to discuss a field crop and to inspect and compare home conditions cannot fail to place local public opinion upon a higher level, and that is the principal opinion to be considered in influencing the farmer.

Instead of expending time and force in moulding State, city, and county influences which have but slight practical results in changing rural conditions, the Farmers' Co-operative Demonstration Work makes a direct attack on the men who should reform. It reaches them in a practical way and establishes a different local standard of excellence for farming and for living.

The initial move is an aroused public sentiment in favour of doing better.

INSTRUCTION CONFINED TO A FEW ESSENTIAL SUBJECTS.

It is of the greatest importance to confine the work to a few standard crops and the instruction to the basic methods and principles which stand for the best results, and to repeat this line of instruction on every occasion until every farmer works according to some system and knows the methods that make for success instead of charging failure to the moon, to the season, to the soil, or to bad luck. It requires several years to so impress these teachings upon the masses, even when supported by demonstration, that they become the general custom of the country. The first year a few try the plan on small areas; the second year these greatly enlarge the area, and some of their neighbours follow their example; the third year possibly 40 or 50 per cent. adopt some of the methods, and so work progresses by the force of demonstration and public opinion until its general adoption is secured. No one is asked to believe anything not clearly proved.

SPECIAL FEATURES OF THE WORK.

In most of the Southern States the average farmer works with one mule. The cultivation of cotton and corn is a slow process; too much of it is done with the hoe.

To remedy this, resort is had to demonstration. The agent in some cases drives a team of strong mules or horses hitched to a waggon filled with improved implements. At the field meetings this team and the improved implements are used to show how much more and how much better work can be done in a day by having good equipment. It is especially emphasized that cotton and corn should be grown without using the hoe, thus saving one-third the expense. It will be noted that the earning capacity of each worker upon a farm is almost directly in proportion to the number of horses or mules for the use of each. This is startlingly true outside of the rice, sugar-cane, and market-garden districts. In North Dakota each farm worker has five horses, cultivates 135 acres, and has an earning capacity of $755·62 yearly; in Iowa each labourer has four horses, tills 80 acres of land, and earns $611·11 annually;

while in Alabama each farm labourer has three-fifths of a mule, works 15 acres, and earns $143·98. In the case of tenant farmers the earning capacity (which is the total product of any crop in the State divided by the number of workers) should be divided approximately by two.

One of the conditions of securing a greater net income is to stop buying food products and live on what the farm supplies. If greater variety is wanted, produce it. Another condition is to accomplish more in a day.

EFFECT OF THE WORK ON THE FARMER.

Every step is a revelation and a surprise to the farmer. He sees his name in the country paper as one of the farmers selected by the United States Department of Agriculture to conduct demonstration work; he receives instructions from Washington; he begins to be noticed by his fellow-farmers; his better preparation of the soil pleases him; he is proud of planting the best seed and having the best cultivation. As the crop begins to show vigour and excellence his neighbours call attention to it, and finally when the demonstration agent calls a field meeting at his farm, the farmer begins to be impressed not only with the fact that he has a good crop, but that he is a man of more consequence than he thought. This man that was never noticed before has had a meeting called at his farm; he concludes that he is a leader in reforms. Immediately the brush begins to disappear from the fence corners and the weeds from the fields; the yard fence is straightened; whitewash or paint goes on the buildings; the team looks a little better, and the dilapidated harness is renovated. Finally, the crop is made, and a report about it appears in the county papers. It produces a sensation. A meeting is called by the neighbours, and the farmer is made chairman; he receives numerous inquiries about his crop, and is invited to attend a meeting at the county seat to tell how he did it.

He made a great crop, but the man grew faster than the crop. There can be no reform until the man begins to grow, and the only possible way for him to grow is by achievement—doing something of which he is proud. He is a common farmer. What line of achievement is open to him but doing better work and securing greater results on his own farm? As soon as the man begins to grow he will work for every rural betterment.

In the Southern States nearly one-half of the farms are tilled under the tenant system. In South Carolina, Georgia, Alabama, Mississippi, and Louisiana more than 60 per cent. of the farms are worked by tenants. The poor equipment of such farms and the low earning capacity of the tenant appeal strongly for help.

The tenant is urged by the demonstration agent to make a better crop and raise everything necessary for his support. He is shown that as soon as he proves himself to be a progressive and thrifty farmer it will add to his credit. He can then buy upon better terms and will soon own a farm. The landlord is seen and urged to look more closely after his farm; to improve his farm buildings, because this is necessary to the securing and retention of the best tenants; to furnish better implements or assist his tenant to purchase them; and to insist that good seed shall be used, and that there shall be better tillage of the crop. Many proprietors take the deepest interest in having their tenants taught better methods. They call meetings and scatter farm literature, thus creating a sentiment favourable to the demonstration work.

RURAL IMPROVEMENT THE NATURAL RESULT OF THIS WORK.

The agents of the demonstration work are thoroughly drilled in progressive steps. When the rudiments of good farming are mastered, the farmer secures a greater income for his labour. An important part of this greater net earning capacity is good farm economy and greater thrift. Farm economy dictates the production of the largest crop possible to the acre at the least expenditure of money and without impairing the productive capacity of the soil. It also includes the planting of crop of the greatest value to the acre, provided the cost of production is not proportionately increased, and it teaches a more economic support of the family, team and stock, which is based upon home production of all the food and forage crops consumed. For the family more use must be made of milk, eggs, the vegetable garden, and fruits; for the stock there should be better pasture and hay, especially the abundant use of legumes. Thrift demand the proper housing of family, teams, and tools, and the more economic expenditure of the greater gains of the farm arising from greater earnings and more economy. The only way to successfully attack such problems is by an example.

Long-time customs cannot be overcome by writing a book. One might as well write a book to teach better sewing. Poor farming is the natural result of a lot of bad practices and must be treated rather as a defect in art than a lack of intelligence. It is not assumed, nor is it the intention to assert, that agriculture is not one of the greatest of sciences, but at the beginning it must be treated as an art and the best method adopted.

Then it is shown that this greater income should be applied to the reduction of debt, the betterment of the family and the home, and the improvement of rural conditions. Co-operation is then taught in buying and selling, but cooperation is of little avail in buying if the farmer has no money, and it is impossible in selling if his crop is mortgaged for advances.

The fundamental basis of the work of the Department of Agriculture is to increase the efficiency of the farmer.

If there is better variety of cotton seed in Georgia or Texas, then the other cotton-producing States should immediately have the benefits. This is precisely such work as the Farmers' Cooperative Demonstration Work is doing in the South. It has been instrumental in the introduction annually of 100,000 to 500,000 bushels of better cotton seed. This has resulted not only in a large income in yield per acre, but an improvement in the staple.

These better varieties of cotton seed are of earlier maturity than the old. This cotton is picked on an average six weeks earlier in the fall, which gives the children six weeks more time for school and allows the farmer to prepare his land for the next season's crop. The old plan was to pick cotton all winter. The loss of cotton and the lowering of the grade by the winter rains made this plan an economic crime, and its debarring the children from attending school caused it to be a social crime. These old methods will soon be a thing of the past.

This is truly a national work, and wherever put in operation with sufficient intensity to influence public opinion these results have rapidly followed:—

(1) Increased yield per acre.

(2) The purchase of more and better horses or mules.

(3) Great increase in the use of better implements.

(4) General interest in seed selection and the use of best seed.

(5) Home and school improvements.

(6) More months of schooling.

(7) Better highways.

(8) Increase of a healthy social life in the country.

(9) Intense interest in agriculture.

Improved rural conditions already established.

While the State agents of the Farmers' Co-operative Demonstration Work were in Washington, September 1, 1908, arranging some details of their work for the year 1908-9, they called upon Secretary Wilson, and in response to inquiries made by him the following facts were brought out:—

Mr. T. O. Sandy, of Burkeville, Va., State agent, reported that the demonstration work was commenced in Virginia in January, 1907. Up to this time it has been exclusively conducted in the counties south of the James River, where tobacco was the staple cash crop, under the effect of which farms had deteriorated in productive capacity and value until many were on the market a short time sine at $5 to $8 an acre. Most of the hay and corn for the work animals was imported. Two hundred and thirty-two thousand dollars' worth of hay was imported within a radius of a few miles of Burkeville in one year for home consumption. The average yield of corn was 5 to 10 bushels an acre. Last year on Mr. Sandy's demonstration farm the yield was 4 to 6 tons of hay, or 75 bushels of corn to the acre.

One of the demonstrators raised 85 bushels of corn an acre. The effect of these yields was to increase the number of demonstration farms from twenty-seven last year to nearly twelve hundred this year, and to stop the importation of hay just as fast as lands can be prepared and seeded to grass. Nearly all lands about Burkeville have doubled in value, and some advanced threefold since the demonstration work commenced. As soon as the farmers found they could produce hay and corn profitably, they wanted to engage in dairying and stock raising so as to use their idle lands. A creamery and an ice plant have been built this season at Burkeville, with the guaranty of a business requiring a thousand cows, the bank there advancing funds to purchase many of the cows, while commercial dairies are springing up in adjoining counties. This has had an immediate effect on the improvement of home conditions, because the estimate of farm life has changed. It had been thought that farming in Virginia could not be made profitable. Many farmers moved away and nearly all ceased to spend much money in farm improvements. As soon

as they saw the demonstration work they commenced to improve. Eleven farmers in one section put hot-water heating and sanitary closets into their houses the past season.

Mr. W. F. Proctor, of Tyler, Tex., in charge of the demonstration work in eastern Texas, said that his territory includes about sixty counties—all infested with the boll weevil. The soil is mainly a sandy loam, well drained and well wooded, making an ideal section for the hibernation of the weevil. The weevil has caused such loss of cotton in Harrison County, Tex., that the crop in 1906 was less than one-fourth the normal quantity. Cotton being the principal cash crop, general depression followed; some farms were abandoned and a general abandonment by tenants was threatened. An appeal was made to establish the Farmers' Co-operative Demonstration Work in Harrison County in an intensive way. The people were asked to raise money for improved seed. They raised $1,000, and later increased the amount to $1,700. An agent was sent to the county, and 300 demonstration farms were established. Last year, though exceedingly unfavourable for cotton, the increased yield over 1906 was 3,500 bales, and this year under the general adoption of the system the increase is over 16,000 bales, or a gain of $748,000 in value, including seed, for the year in one county.

At Sulphur Springs, Hopkins County, there has been a similar experience this season. The county agent, Mr. W. L. Bryson, located demonstration farms along the main highways leading to Sulphur Springs for 4 or 5 miles out, so that every farmer entering the city could not fail to observe them. Prominent citizens estimated the value of his work this year at $250,000 for the county. This better financial condition resulted in many improvements in homes and schools.

All present agreed in stating that the Farmers' Co-operative Demonstration Work was readily accepted by the farmers and aroused among them intense interest in agriculture, especially where field schools were held and the plan of the boys' corn and cotton clubs was carried out.

The agents emphasize the great gains in crops under the system of farming taught in the demonstration work, and state that the immediate effect of these increased earnings is to better the conditions of the farm and of rural life generally, particular stress being laid upon the following:—

(1) Better seed and some plan for rotation of crops.

(2) Better teams and implements.

(3) Reduction of debts.

(4) Ownership of land.

(5) Improvement of home—more comfortable and neater clothing; more fruit; farm canning outfits in many cases, etc.

(6) More months of schooling.

(7) General co-operation in improvement of farm stock, etc.

Instances were cited where a single demonstration showed the farmers in the Yazoo Delta how they would increase their yield of corn from 14 to 70 bushels an acre without additional expense, and where a single small farmer saved $500 last year in commercial fertilizers from information derived from an agent in the demonstration work.

Many farmers are now working cotton without the use of the hoe or plough. Mr. Bamberg brought out this fact clearly and showed its great economic importance.

Mr. Savely called attention to the fact of field schools, stating that they were very influential in promoting home improvements, and that such schools were occasionally held on farms of coloured men as well as white.

Mr. R. S. Wilson gave an illustration of the rapidity with which practical information along agricultural lines spreads through a district. As the result of ten months' work in Congressman Hobson's district, a majority of the farmers were tilling their lands better; they were raising more corn and forage crops, and many had adopted the Department plan of seed selection.

Mr. J. L. Quicksall spoke of the great improvement in agriculture and the betterment of rural conditions in Central Texas since the demonstration work commenced.

Dr. S. A. Knapp stated that the southern people were awake. In a number of States the patriotic women are forming rural improvement clubs for the betterment of home conditions. In North Carolina they put a model kitchen on a car and sent it about the State. Congressmen are interested and are calling for agricultural speakers. It has been the general custom of southern farmers, whether in cotton, sugar, rice, or tobacco districts, to depend on one cash crop and buy their supplies of food and clothing with the proceeds. This is rapidly becoming a thing of the past. All of our agents urge the production

upon the farm of all home supplies possible. The result is that the money which formerly went for current debts now goes into home improvements, better clothing, better stock, and more schooling. The earlier maturing cotton introduced and made common by our agents allows six weeks more schooling annually for the children. Rural improvement requires considerable expenditure of money, which must be provided by the farmers through an increase in the products of the farm with a decrease in their cost.

A large number of inquiries were sent out to ascertain the present conditions in the South and the effect of the Farmers' Co-operative Demonstration Work. The reports all show great improvement in rural conditions.

Without exception they fully corroborate the claim made for the Farmers' Co-operative Demonstration Work. Out of the hundreds of replies received, the following from a live worker in Texas is presented as typical in showing the general tenor of the reports made :—

Giddings, Tex., September 21, 1908.

Dear Sir,—Growing out of my efforts and the example and the moral support of the business men, thirty cream separators have been bought by the farmers around here. Over $2,000 has been invested in good milch stock (one $400 bull from another part of the State has been shipped into the country), and about $500 worth of cream per month finds its way to the creameries. People all over the country are planting winter forage crops and besieging me for all kinds of information. Every one of these people is securing some good pigs to dispose of the milk.

Two business men have volunteered to put in a creamery just as soon as there is cream enough to justify it. They would do it now if I'd let them, but it is best to wait a while. Prior to March 1 of this year there was not a separator in this county.

A majority of our German farmers are very thrifty and have a good garden. All lands in this section are fenced. Possibly one-half of 1 per cent. have log pastures of any size.

Corn is selling on the streets at from 40 to 50 cents per bushel, and hay from $5 to $10 per ton, with plenty offering. People tell me that $20 for hay and 75 cents for corn have been ruling prices until this year, but the excellent season accounts for this almost if not as much as the improved methods. Regular articles on corn and feed crops were supplied the papers during seed time, and hundreds of people are cashing this advice now. Quite a few have added to their team force and equipments, bought additional lands, etc., this year, but prior to 1908 there was not enough work in any one community to tell any decided effects.

Perhaps there has been more good accomplished for the schools than any other outside item. Through addresses to summer normals and teachers' institutes and through direct contact with schools, a general awakening is noticeable among our county people. Probably not a rural school in the county of Lee but will increase the salary, add to the equipment, or lengthen the school term. This may be attributed to a combination of causes. We come in for our share. One thousand homes in Lee and Washington counties will be invaded this winter by bulletins and circulars, for which the teachers are asking as aids to the teaching of agriculture, which from now on is made mandatory in Texas. Milam, Williamson, Fayette, Burleson, and Bastrop counties will all ask for these bulletins for their pupils in agriculture.

Two German coach stallions, costing $3,000 each, and one Biltmore Jersey bull, costing $400, have been added to Lee County's list, and two stock companies about completed will soon send a buyer to Kentucky or Tennessee for two standard-bred $500 horses. Over $1,500 worth of milch cows have been bought, most of them from beyond the county by farmers establishing dairy herds. Any milch cow having any milking qualities brings a good price here now.

I had the pleasure of organizing and conducting a school of farmers—men and women—in the art of canning corn and such vegetables as are difficult to keep. One such class was at Dime Box, in the extreme western part of the county. Much interest was manifested, and it took only four days of my time.

These are, as briefly as I can state them, the kindred but indirect results we have obtained in this county. The other counties we have worked show signs of improvement, but not so marked.

I have no further comment. This is a faithful recital of existing facts which speak for themselves.

Respectfully yours,
W. W. Campbell.

BETTER CONDITIONS AMONG THE COLOURED PEOPLE.

It was mainly through the influence of Dr. H. B. Fissell, President, Hampton Institute, Virginia, and Dr. Booker T. Washington, President, Tuskegee Institute, Alabama, that demonstration work was inaugurated for the coloured.

Where large sections of country are tilled mainly by coloured farmers owning their lands, it seemed advisable to appoint coloured agents. In Virginia there are four, in Alabama two, and in Mississippi one. In all other cases the white agents look after the coloured farmers, and do it faithfully.

In the main the coloured farmers respond as readily to the demonstration work as do the whites. In Alabama and Mississippi the coloured agents are graduates of the Tuskegee Institute; in Virginia they are mainly graduates or have attended the Hampton Institute.

In an article in the *World's Work* for July, 1908, entitled "Teaching a Man his Job," Booker T. Washington stated: "If I were to name a single instance of this new policy of taking education to the man on the job, an instance which seems to me more thorough-going and more fruitful of good than any other of which I know, I should refer to the work that the General Education Board is doing in conjunction with the Agricultural Department of Washington, in order to instruct the farmers of the South, by practical demonstrations on their own farms, in the newer and better methods of cultivating the soil. No other single agency, I am sure, is destined to do more in the task of creating the New South."

The following Report, selected from a large number, is a faithful presentation of the work accomplished among the coloured people:—

Tuskegee Institute,
Alabama, September 23, 1908.

Dear Sir,—(1) The demonstration work is advancing very rapidly. I feel safe in saying that 45 per cent. is the minimum of the farmers who have adopted the intensive method of farming in my territory.

(2.) The farmers in my territory have come into possession of better breeds of hogs, a better breed of cows, and also for the past two years they have raised more chickens than ever before. I am sure in saying that prior to the introduction of the demonstration work only 25 per cent. of farmers practised the above, and now 35 per cent. is the lowest.

(3.) The Jesup agricultural wagon (a team and wagon donated by Hon. Morris K. Jessup, of New York, for this work) has played a prominent part in the demonstration work. I fitted up the wagon with a portable garden and drove to various meeting places, as indicated on demonstration map, and here gave concrete illustrations of how gardens should be made. A storekeeper informed me the other day that he sold more vegetables for eating purposes, such as cabbage, potatoes, peas, onions, etc., in three months last year than he has sold during all of 1908. This is due to the fact that in every meeting the farmers are urged to make better gardens.

(4.) In my territory the percentage of pasturing is very low, since farmers generally let their stock run out after the crops are gathered and "tie them up" while the crops are being made. Prior to the beginning of the demonstration work there were about 10 per cent. of pastures. There are now 12 per cent.

(5.) The farmers in my territory are just beginning to leave the old rut of buying corn and hay to tide them over the cultivation period of their crops. Prior to the introduction of the demonstration work the average of the farmers who raised enough corn to last them through the season was as low as 7 per cent.; now it is about 12.

(6.) The small farmers are showing a marked improvement in the matter of getting out of debt. A farmer living at Tuskegee, Alabama, tells me that last year was the first time he was ever gotten out of the debt, and says it is due to the fact that he attended the farmer's meetings; and another, at Notasulga, Alabama, sold enough butter, eggs, and vegetables to buy the necessary things from the store, thereby saving the high price charged for advancement. About 10 per cent. of the farmers are out of debt.

(7.) The increase of teams has not been so perceptible, for as a general rule the small farmer tries to keep a pretty good mule or horse, even at the expense of some other very important phase of farm management. But with reference to tools and farm machinery the work has accomplished great results—an increase of at least 28 per cent.

(8.) The rural school condition in my territory has been greatly improved, yet I find that the schools which I touch directly are some better than the average to begin with. The early varieties of cotton have aroused great enthu-

siasm; the people all over my territory have been and are now clamouring for new seed. Messrs. E. W. and B. W. Washington, of Cross Keys, Ala. (both demonstrators), had picked over twenty bales of cotton by September 7 from seed introduced by the Department. Mr. Jackson Donner, of Warriorstand, Ala., informs me that every man in his community is trying to buy, borrow, or beg cotton of him.

(9.) I have given considerable time to the matter of encouraging the people to improve their live stock since I have been doing the demonstration work. I constructed a crate on the Jesup agricultural wagon for the purpose of carrying the best breeds of live stock, such as Berkshire and Poland China pigs and Jersey and Shorthorn calves to the farmers' meetings, and showing them just how they could improve their herds. I am glad to say that the farmers have purchased better live stock, especially Berkshire hogs, from the Tuskegee Institute and other places.

(10.) The farmers are canning a large quantity of fruit and vegetables. At the most of our farmers' meetings we have had exhibits of home-canned vegetables and fruits. The increase is about 40 per cent.

(11.) In our community meetings we have what is known as the inspecting Committee who go around and criticise the homes in general. In this way we keep the subject of applying whitewash and paint ever before the farmers. who are now building better houses and applying more paint and whitewash than I have ever known them to do before.

(12.) The effect of bettering the highways and the construction of telephones is not very appreciable as yet, but in my territory there have been more mail boxes put up within the past two years than ever before. A great many farmers put them up purposely to receive the mail from the Department.

(13.) The degree in which the tenants have been purchasing farms is capable of being perceived. I recall to mind instances while travelling where there was no demonstration work where tenants sought information as to the possibility of buying farms within the bounds of my territory, in order that they might have the advantage of the agricultural instruction furnished by the Department.

T. M. CAMPBELL,
District Agent.

MISCELLANEOUS.

CEYLON AGRICULTURAL SOCIETY.

Minutes of a meeting of the Board of Agriculture, held at the Council Chamber at 12 noon on Monday, the 16th October, 1911.

The Hon'ble the Acting Colonial Secretary presided.

The following members were present:—The Hon'ble Mr. Bernard Senior, The Hon'ble Mr. C. T. D. Vigors, Sir Solomon Dias Bandaranaike, Dr. J. C. Willis, Dr. R. H. Lock, Dr. H. M. Fernando, Messrs. H. F. Macmillan, R. S. Templeton, John Ferguson, G. W. Sturgess, G. Harbord, Tudor Rajapakse Mudaliyar, F. L. Daniel, and L. W. A. de Soysa.

The minutes of the meeting held on the 14th August were read and confirmed.

Progress Report No. 56 was duly adopted.

Statements of expenditure for August and September, 1911, were tabled.

A Report by the Chairman of the Tobacco Committee, together with the Resolution adopted at the last meeting of the Committee, and other connected papers (previously circulated) were submitted by Dr. Willis, who summed up the situation in a speech. A discussion ensued in which the Chairman, Dr. Willis, Mr. John Ferguson, Dr. Fernando, Mr. Senior and Dr. Lock took part.

Dr. Willis submitted the following Resolutions:—

(*a*) "That this Committee does not consider it advisable to continue the Tobacco experiment upon the same lines as hitherto, viz., upon a commercial basis, as as it is of opinion that financially such an experiment must end in failure, owing to the high cost of growing the tobacco and the low price realised from the sale thereof. The Committee consider that such an undertaking is altogether too large for the Agricultural Society, having in view the amount of funds at its disposal."

(*b*) "The Committee, however, are of opinion that it will be a pity to cease the experiment in Tobacco growing in

the Colony, and express the hope that the experiment will be taken up by Government through the new Agricultural Department on scientific lines, and that a tobacco expert be appointed for a term of years with a view to ascertaining the best kinds of tobacco for Ceylon to produce, the various kinds of tobacco which can be grown profitably in the Island, and the districts in which such can be grown. Also, that the Tobacco Expert should train a few officers in scientific tobacco cultivation, so that, on the completion of his agreement with the Government, these officers may be in a position to carry on the cultivation upon a commercial basis, and also act as Instructors in the future."

The resolutions were adopted.

The Chairman enquired as to the circumstances under which Mr. Cowan was given notice. Dr. Willis and Mr. Senior explained that this action was taken in the interest of the Society subject to the approval of the Board, inasmuch as the experiment had been concluded, and there was no object in retaining Mr. Cowan's services.

The Chairman then put the question to the meeting whether the action of the Tobacco Committee in giving notice to Mr. Cowan was confirmed, and declared that the confirmation was unanimous.

Dr. Willis referred to certain proposals submitted by Mr. Harbord, Superintendent of the Experiment Station, in connection with the tobacco experiment. He announced that the Tobacco Committee were not in favour of these proposals, and moved that they should not be accepted.

The motion was carried.

Mr. H. F. Macmillan, Curator, Royal Botanic Gardens, Peradeniya, read his paper on "Fruits Worth Growing in Ceylon," for which he was accorded a vote of thanks.

C. DRIEBERG.
Secretary, C.A.S.

Colombo, 16th October, 1911.

TOBACCO (FOR THE EUROPEAN MARKET) IN CEYLON.

THE EXPERIMENT AT MAHA ILUPPALAMA.

REPORT BY J. VAN LEENHOFF,

Late Chief of Tobacco Division of the Transvaal; late Government Tobacco Expert of Porto Rico and of the U.S.A. Department of Agriculture, Washington, D.C. Holder of certificate of the "Ecole d'application des Tabacs," Paris, and of the Imperial Tobacco Manufactures, Strasburg, Germany. Reported on Tobacco Industries of Cuba, Rhodesia, Orange River Colony, and Mauritius.

Introduction.

I was informed in a letter from the Secretary of the Ceylon Agricultural Society, dated March 21, that the Tobacco Committee of this Society requested me to make a report on the present tobacco experiments on the Maha Iluppalama Experiment Station, and that the Ceylon Government appointed me to visit and report on the Jaffna, Trincomalee, and Dumbara Districts with regard to the tobacco industry generally, and to offer advice on lines of possible improvement.

Up to the present I finished my investigations in the Trincomalee and Jaffna Districts; but as it was desired that the report on the experiments at the Experiment Station should be prepared as early as possible, a separate report on these experiments is given herewith—the general one to be prepared some months later.

This report is somewhat hastily prepared, and I shall therefore be glad to explain in person any points on which I may have omitted to touch, if requested to do so.

Visit to the Maha Iluppalama Station.

I visited the Maha Iluppalama Station twice, *i.e.*, once officially on behalf of the Society on April 9, and once as a private visitor in the middle of February.

To the Officer in Charge of the Station (Mr. G. Harbord) and to the Tobacco Officer (Mr. Cowan) my intended visit on April 9 had been duly announced by the Society, and these gentlemen were requested to meet me at the Experiment Station so as to show me the crops, plantations, and everything connected with the work. On my arrival at the station (from Jaffna *via* Anuradhapura) I had not the pleasure, however, of making Mr. Cowan's acquaintance; but Mr. Harbord was present, showed me round, and gave me all information I

required, to enable me to judge the work and conditions, for which my most cordial thanks are due him.

I went carefully over the non-irrigable and irrigable tobacco land, seed-beds, tobacco fields, sheds, and last, but not the least, studied carefully the quality of the leaf of last year's crop. Notes were made of the rainfall returns, of which copy is annexed. The area under cultivation was estimated, the condition of the crop in the field and quality of soils were noted; the tobacco piles and the sorting of leaf were observed, and samples of different grades were taken for further investigation purposes, if required; photographs were taken of the two fields and the tobacco shed, which will help the Committee in forming an idea of the present actual condition.

Opinion on Field Work.

Non-irrigable Land.—On the non-irrigable land it was intended (according to information received on my first visit) to plant an area of about 20 acres. On my second visit, however, I did not find more than about an acre planted, and in a *very* bad condition, as may be seen from the photograph "A," owing to want of rain perhaps. The plants on the photograph are more than two months old. The soil on this portion is a red loamy soil with a small amount of sand, which looks to be an excellent soil for tobacco culture, provided the chemical composition is such that a good burning power can be expected. However, if the chosen planting season is altogether wrong (as has been apparently the case in the present experiments), no good results can be expected. The rainfall returns and the character of the soil indicate clearly that, if a fast-growing tobacco crop is our aim, a little over two inches of monthly rainfall (as is the average during six years in January, February, and March) is far too low for the conditions. If therefore the planting had been started towards the beginning of, or probably about the middle of, November and finished by the end of December or thereabout, an excellent crop could have been expected, although nothing can be said as to what kind, variety, or type of tobacco would show the best results. The most important experiment necessary to answer this question has not been carried out, which would have undoubtedly given useful information.

I quite admit that, if the so-called "dry land farming" principle with constant cultivation had been applied on this plot, instead of simply following exactly the Sumatra (where conditions are totally different) way of field treatment, a much better crop would have been produced, and, in addition, by using self-bred seed, which have shown adaptability to the local conditions, great improvement could have been effected.

Irrigable Land.—With regard to the *irrigable tobacco* field, with a gravelly gray loamy soil, I only found about two acres planted out, the plants doing very badly indeed for the same reason as before stated.

The effect of shade was clearly shown in plants growing under the shade of trees doing much better than their fellows; they were, however, not free from the effects of the conditions above indicated. The same remarks apply to this plot as that which is non-irrigable. The effect of shade is mentioned to indicate the expected improvement for cigar wrapper leaf by planting in rainy or cloudy season; this also promotes quicker growth, and result in top leaves giving shade to lower leaves. Shade makes the leaf finer, rib thinner, and colour lighter.

Seedlings.—During my first visit I observed the seedlings in the seed-beds and noted that they were sown much too thickly, and in consequence were long-stemmed with undeveloped root system, and were already too large for transplanting purposes. It is a well-known fact that such seedlings have not much resisting power to withstand the shock of transplanting, and are much more liable to disease and insect attacks. To this and the ravages done by the tobacco stem borer is due the great loss of plants in this field. Thinner sowing, transplanting at earlier stage, and covering in the seed-bed with muslin cloth would have prevented this loss (see my Farmers' Bulletin No. 71, Tobacco Seed-beds). The muslin cloth covering is used to prevent the moth of the borer depositing its eggs on the foliage of the seedlings which are carried with them to the field at transplanting time.

Resuming the field work, it can be said that—

(*a*) The planting season was probably wrongly chosen;

(*b*) When attempts were made to grow tobacco out of season, more or less "dry land farming" principles should be applied instead of simply imitating work as is done in other countries where conditions are totally different;

(c) Production of seedlings were bad;

(d) Seed used was not bred for the purpose;

(e) No proper manuring appears to have been applied having regard to the bad burning qualities of last year's tobacco crop.

Tobacco Shed.—With regard to the shed (of which I also enclose copy of photograph), my opinion is that for an experimental crop, and also for a plantation on a small scale, in general, much smaller sheds are required. Sheds should be of such a size that they can be filled with the harvested crop in one or a few days only, so that the curing can be uniformly done and the leaf treated. In a dry atmosphere the sheds should be practically hermetically tight, but provided with shutters so as to control air humidity inside the shed almost at will, by opening and closing the shutters when required. In the first stage, for instance, the drying process should be slow, the ventilators should be hermetically closed in the daytime, and somewhat opened at night. After the required colour is obtained, ventilation could go on quicker so as to simply dry the leaf. Some idea of the process is given on pages 27, 38, 39, and 70 in Porto Rico Bulletin of my tobacco investigations in 1903-04 there. An idea is also given of the fermenting question on pages 41-44 of the same Bulletin, and both subjects are also discussed in the "Transvaal Journal of Agriculture" for October, 1906, No. 17.

Opinion on the Fermented Tobacco Leaf.

The leaf tobacco in bulk was carefully studied twice, and my conclusion is that the tobacco, as was to be expected, is not a success, for the following reasons:—

(1) The burning power is *very bad.* Samples were taken of almost all grades, match lighted, and the leaf carefully dried first before bringing the leaf to the flame. In almost all cases the leaf flamed and coaled, and in no case was there a sign of good fire-holding capacity in the leaf. For cigar tobacco, especially cigar wrapper tobacco, a freely burning capacity is required.

(2) With regard to colour and size of leaf, I roughly estimated that only 20 per cent. (mostly consisting of bottom leaf only) would be suitable for ordinary cigar wrapper purposes, if the bad burning is into taken into consideration and if the elasticity of leaf is sufficient. The latter point was not tested, the tobacco not being in "condition." As to price, that also depends how the cigars work out, taking into consideration how many cigars can be wrapped cut of a pound weight.

(3) The flavour of the leaf is more or less "raw" for want of fermentation, and this is specially the case with the top leaves and large part of middle leaf. About 80 per cent. of the tobacco I consider to be unsuitable for cigar wrapper purpose—*i.e.*, for the European market (as I am informed) it was intended for.

(4) While only attempting to keep light colours in the fermenting process, the tobacco which might have been suitable for filler tobacco has been sacrificed; as for filler tobacco fermentation, the highest temperature should in some cases be raised to about 80° so as to develop flavour and aroma. Fermentation also improves burning capacity.

As will be seen in the records of temperature kept at the Experiment Station, the maximum was only 44° in one case. Considering this tobacco, the temperature should gradually have been raised up to about 55° for wrapper and about 80° for filler purposes, which could have been done if sufficient precautions were taken. For the bottom leaves, however, a temperature of about 40° to 44° is considered to be sufficient.

If sorting, for instance, in three qualities, *i.e.*, dry, medium, and fat, is undertaken before fermentation, or more simply bottom, middle, and top leaves kept quite separate in the fermentation, each kind could have been fermented to its best advantage. Unnecessary handling of leaf must be prevented, as I found a rather large percentage of broken leaf, and therefore loss of moisture should be prevented as much as possible.

Suggestions.

Report on the Experiment.—From the report at the end of February on this tobacco, I notice that it was the intention to send some sample bales of this tobacco abroad; therefore I strongly suggest that this should not be done, as it will result in spoiling the reputation of Ceylon-grown tobacco for the future. Being produced at the Ceylon Government Experiment Station, the market will, of course, draw the conclusion that this is one of the best kinds of tobacco Ceylon is able to produce; and the tobacco being not a fair sample at all of what Ceylon is capable to produce, it would certainly spoil the reputation of Ceylon as a tobacco-producing country, which should be avoided at any cost.

Afterwards capital will not likely to be found for the Ceylon tobacco industry, which would certainly be a great pity.

We should first be convinced ourselves of having produced a good leaf before thinking about exporting sample bales to open markets, especially when of inferior quality, and the cost of production higher than any country we know of (owing to cost of irrigation in case of planting in dry season).

In the same report it was said that the Committee decided to make two kinds of cigars out of the tobacco on hand. If the leaf itself is not of a sufficient quality, what will be the finished article of the cigar wholly made of that one kind of tobacco?

In my opinion the expenditure is not warranted, as there is no object gained in making cigars out of the leaf in hand. If these cigars are not appreciated (very likely) there is no proof that cigar tobacco cannot be produced; and even if there is an appreciation, would that indicate that we are on the right road of growing the best kind of tobacco, the best variety of seed, applying best method—or what?

In the same report it was said that the area to be planted would be 50 acres. During the interval of my two visits, however, *i.e.*, about six weeks, I noticed only about two acres planted. I also found the following statement in the report:—

"About 15 to 20 acres near the bungalow are not irrigable, so this will afford a test as to whether tobacco can be grown there without irrigation."

My first impression, which I still hold, is that in Ceylon tobacco is over-irrigated; but is the above test a fair one, if it is undertaken during the driest part of the year and the soil not properly prepared and cultivated for the purpose in view?

The tobacco industry being so specialized with such large number of branches and sub-branches, that no quick and good results can be expected if work of tobacco investigation is not undertaken by a tobacco expert, thoroughly trained for the work of tobacco investigation. Besides having gone through a course of agricultural and analytical chemistry and made scientific tobacco field work, curing and further preparation for different markets his speciality, he must have a practical experience of curing and manufacturing cigar, cigarette, and pipe tobacco, so as to enable him to be a *judge of leaf tobacco.* He also should have wide experience of other tobacco-producing countries, so as to be able to conclude in a minimum time which kinds of tobacco have the best chances for success in Ceylon. His first work should consist of acquiring knowledge of local conditions and organizing the Government and Society's Tobacco Investigation work and conducting the most important experiments in several localities at the same time.

It would be important that a somewhat complete Tobacco Bulletin should be published for Ceylon, containing (1) description of soils and climate and present methods of Ceylon tobacco culture; (2) discussion of possible kinds of tobacco varieties and types to be tested in the different districts or localities, which are promising for tobacco culture; and (3) suggestions for improvement.

During the season pamphlets should be published so as to enlighten present planters on points on which immediate improvement can be made. After it has been found out which kind of tobacco will give best commercial results, the tobacco culture should gradually be improved by reducing cost of production, *i.e.*, increasing yield per acre and improving quality of leaf for the different purposes in view, and some scheme of co-operation should be worked out to handle the crops of the small planters to the best advantage. With an annual vote of say 30,000 to 40,000 Rupees for about three years, I consider the tobacco work can be put on a sound footing.

As the estimated expenditure of the present crop produced at the Experiment Station at Maha Iluppalama is about Rs.15,000 to Rs.16,000, I strongly recommend that the work *should be stopped at once,* as no *information* can be obtained by the present method of tobacco experimenting.

As has already been said, the above report is hastily prepared, and personally I am fully convinced that some points could have been discussed more in detail, and that there is a likelihood that such points on which your Committee might wish further information have been omitted. I shall therefore only be too glad to reply to any questions to my utmost power.

J. VAN LEENHOFF.

Colombo, April 12, 1911.

AVERAGE MONTHLY RAINFALL RETURNS.

	37 Years. Trincomalee.	Six Years. Maha Iluppalama Experiment Station.
January ...	5·76	2·88
February ...	2·27	2·25
March ...	1·50	2·60
April ...	2·20	6·38
May ...	2·40	2·19
June ...	1·28	1·19
July ...	2·19	2·36
August ...	4·20	2·50
September ...	4·63	2·64
October ...	7·96	11·51
November ...	14·10	9·53
December ...	14·40	7·65

MONTHLY STATEMENT OF EXPENDITURE.

1910.	Rs. c.	Rs. c.
January ...	321 90	
February ...	432 45	
March ...	499 39	
April ...	1,769 24	
May ...	1,223 98	
June ...	1,688 28	
July ...	722 3	
August ...	1,819 59	
September ...	1,410 34	
October ...	1,388 80	
November ...	1,190 11	
December ...	1,610 44	
		14,077 55
1911.		
January ...	1,610 30	
February ...	1,133 79	
		2,744 09

This *does not* include use of land, buildings, and staff of the Station.

TEMPERATURES OF JAVA AND SUMATRA TOBACCO UNDER FERMENTATION.

First Bulk. 1910.

		°			°
August	25	30	September	23	36½
,,	26	35	,,	24	37
,,	27	38	,,	25	37
,,	28	39	,,	28*	30
,,	29	40	,,	29	32
,,	30*	28	,,	30	34
,,	31	28	October	1	35½
September	1	32	,,	2	37
,,	2	34	,,	3	38
,,	3	35	,,	4	39
,,	4	35	,,	5	39½
,,	5	35	,,	6	39½
,,	6	35	,,	7	40
,,	7	35	,,	8	40
,,	14	36	,,	13*	27
,,	17*	32	,,	14	31
,,	18	34	,,	15	32
,,	19	35	,,	16	33
,,	20	36	,,	17	33
,,	21	36	,,	18	33
,,	22	36	,,	19	33½
			,,	20	34

* Tobacco re-stapled.

Second Bulk. 1910.

		°			°
October	22	25	November	14	40
,,	23	29	,,	17*	26
,,	24	33	,,	18	30
,,	25	36	,,	19	32
,,	26	39	,,	20	34
,,	27	40	,,	21	35½
,,	28	42	,,	22	37
,,	29	42	,,	23	38
November	2*	25	,,	24	39
,,	3	28	,,	28*	27
,,	4	31	,,	29	31
,,	5	33	,,	30	35
,,	6	36	December	1	39
,,	7	40	,,	2	43
,,	8	41	,,	3	44
,,	9	41	,,	4	44
,,	10	41	,,	5	44
,,	11	41	,,	6	43
,,	12	41	,,	7	43
,,	13	41			

REPORT BY MR. E. COWAN, SUPERINTENDENT OF THE EXPERIMENT.

I have the honour to send you my report on the Tobacco Experiment. In all 20 acres of tobacco were planted from imported Java and Sumatra seed, which realised a crop of 6,700 lb. dry tobacco, or 335 lb. per acre, at a cost of Rs.16,604·17; of this Rs.5,210 was salaries and travelling expenses, which for the acreage planted is heavy, as the same salary would have been sufficient for double the acreage. From this sum must be deducted a sum of Rs.1,759·45 for work done for the 1911 planting, as the whole of the land has been dug over and is ready for planting; and also it must be remembered that the drying sheds were built to last three years, so that the total expended on these, Rs.2,239·94, must be divided and Rs.1,393·28 deducted from the cost of the 1910 experiment, which includes Rs.600 for a wire fence which, as it is a permanent one, should not be charged to Tobacco. This brings the actual expenditure down to Rs.7,141·25, which is divided as follows:—

Drying Sheds	746·64
Manure ..	323·00
Clearing by Contract ..	487·84
Railway warrants ..	100·00
Sundries, Thermometers, Strings, etc.	314·75
Cooly wages, including picking, cultivating, planting, sorting, fermenting	5,169·02=7,141·25

In reviewing the experiment it must be taken into consideration that the work was all new to everyone except myself. Coolies had to be taught, and were therefore slower, and so work was more expensive than it would have been if they had been trained to the Tobacco work, and my best thanks are due to the Superintendent, Maha-iluppalama, for

* Tobacco re-stapled.

the very great help he has been throughout the experiment. The weather was not all it might be, as the first planting never came on owing to the drought, and the last planting, a great deal of it, was killed by too much flooding of the land; but the greater portion of the Tobacco was very fine, good strong trees and fine quality equal in my opinion not to the best Sumatra tobacco, but certainly to the average Sumatra leaf. The fermenting was the trouble, as I told the Committee it would be, as there was not the bulk to produce the heat required to thoroughly ferment the leaf out, and without sufficient bulk this cannot be done, and that the first shipment was not fermented out, is shown by the cable received from Bremen saying tobacco was spoilt on the journey, which means it had lost some of its colour. This was what I was afraid of, and I told the Committee at the time it would do so. With regard to Mr. VanLeenhoff's report, I do not wish to say anything except that I do not agree with him. He reported on a scientific basis, and disagreed with my methods because they were based on the Sumatra manner of planting; but it must be remembered that the Sumatra methods are the ones that I know, and the ones which we agreed were to be tried, and that the experiment was not a scientific one for the object of research, but a purely commercial one to find out if tobacco could be grown in Ceylon which would command a market in Europe, and this, I maintain has been done, not, I admit as yet at a remunerative price, but still, although the 3,000 lb. which have been despatched were admitedly spoilt on the journey, yet it has fetched a price, and the buyers are willing to take all we can send them, showing that they, at any rate, see some profit in it. We are told when the experiment was first mooted that for two years at least we must be prepared to loose our money, as the European market would boycott the Tobacco, and until we found out a market there would be no money in it, but I maintain, that the experiment of 1910 has been successful in this, that we have proved that Tobacco *can* be grown in Ceylon which will command a market in Europe, and I consider myself that, given a bigger acreage, say 50 acres, there will be no difficulty in getting bulk enough to thoroughly ferment the Tobacco out.

I particularly wish to point out that no true experiment can be expected to realise *all* the required results at the first attempt; if it did, it could not be correctly called an experiment. In growing Tobacco not for a scientific purpose, but for a commercial purpose, I contend that to be of any value the process must be continued until we arrive at perfection as required by the particular market we are trying to secure. Our first attempt has not been so successful as we might wish perhaps, but this we never have expected, nor have we ever led anyone to believe that we expected an unqualified success. In the light of our present experience we shall now be in a position to retrieve some of our errors, and, with a fair share of luck as regards weather to make any future experiment more of a success. I must, however, differ from Mr. VanLeenhoff in his views that the experiment is altogether a failure, for the simple reason that he criticises the experiment from a different point of view altogther to that for which it was intended.

I would point out that all land, sheds, etc., are ready, if it is decided to continue the experiment, and that cigars are being made at Maha-iluppalama.

EDWARD COWAN.

RESOLUTION ADOPTED BY THE TOBACCO COMMITTEE.

Minutes of a Meeting of the Tobacco Committee—called at short notice to report on Mr. Cowan's Memorandum on the Society's Tobacco Experiment at Maha Iluppalama and submit a definite recommendation as to the advisability of continuing or discontinuing it—held at the office of the Colonial Treasurer on Wednesday, August 16, at 2 p.m.

Present.—Dr. Willis (in the Chair), the Hon. Mr. Bernard Senior, Dr. H. M. Fernando, and Mr. C. Drieberg.

The following resolution was adopted: —"That this Committee does not consider it advisable to continue the tobacco experiment upon the same lines as hitherto, viz., upon a commercial basis, as it is of opinion that financially such an experiment must end in failure, owing to the high cost of growing the tobacco and the low price realized from the sale thereof.

"The Committee consider that such an undertaking is altogether too large for the Agricultural Society, having in view the amount of funds at its disposal.

"The Committee, however, are of opinion that it would be a pity to cease the experiment in tobacco growing in the Colony, and express the hope that the experiment will be taken up by the Government through the new Agricultural Department on scientific lines, and that a Tobacco Expert be appointed for a

term of years with a view to ascertaining the best kind of tobacco for Ceylon to produce, and the various kinds of tobacco which can be grown profitably in the Island, and the districts in which such can be grown. Also that the tobacco expert should train a few officers in scientific tobacco cultivation, so that, on the completion of his agreement with the Government, these officers may be in a position to carry on the cultivation upon a commercial basis, and also to act as instructors in the future."

Dr. Willis undertook to embody this resolution in the form of a report, going more fully into the circumstances under which the experiment was carried out, the lessons to be learned from it, and the reasons which led up to this resolution.

The Committee further resolved, in view of the decision to abandon the experiment, that Mr. Cowan be given notice at once that his services as Superintendent will not be needed after the end of September, and that the thanks of the Committee be conveyed to him for his supervision of the experiment.

C. DRIEBERG,
Secretary.

Colombo, August 16, 1911.

REPORT BY THE CHAIRMAN OF THE TOBACCO COMMITTEE.

Tobacco is, and has long been, grown for the peculiar local market of Travancore in the Jaffna peninsula and in other districts, but this is a coarse tobacco entirely unsuited to the European palate, and it is desirable that we should establish a local industry in the production of a tobacco fit for use by the white man, and saleable at a remunerative price on the European market.

But few experiments have been made in this direction, and though one made in Dumbara some years ago proved profitable for one crop, the success could not be followed up by further successes, and proved to be merely a flash in the pan.

An attempt to turn out of the Jaffna leaf a cigar suited to European consumption, made a few years ago, by buying in the leaf and curing it by a better method, also proved a failure.

Soon after my arrival in Ceylon in 1896 I cultivated at Peradeniya all the various kinds of tropical tobaccos—Sumatra, Java, Cuba, &c.—and satisfied myself that, as far as *growth* was concerned, there was little or nothing to choose among them. With the enthusiasm of a new comer I persuaded a number of people in the Jaffna country to try the Cuba leaf. They sowed it in good time, but as soon as the leaves grew they pulled it all up, saying that such leaves were useless (being too small and delicate), and made haste to try to re-plant the land with Jaffna tobacco in time to save the season.

In this condition the question remained for many years, and the next step obviously was to try a "commercial" experiment with one of the kinds that grew so well, to see what sort of a prospect of financial success lay before the tobacco grower. People are now, after the event, talking as if we should at once have started on a "scientific" course of improving local tobacco and local culture, but this is not the correct way to proceed. First, one must satisfy oneself that the growth on a large scale and the atmospheric and other conditions of curing are satisfactory.

This is what we have done by means of the experiment just concluded, and we now have a grasp of the situation that was entirely lacking previously. We now *know* that Ceylon is suitable for cultivation and curing on a large scale, and that, given proper expert supervision for a number of years and careful scientific experimenting, there is every prospect that a profitable tobacco industry may be built up locally.

Two possibilities lay before the Committee, either to grow at Jaffna or in Dumbara, or to try new land. The ill-success of the recent experiment in curing the Jaffna leaf by European methods, and the difficulty of getting control of a sufficient area close to a factory, and ensuring that the same kind of tobacco was grown in the same way on all the little plots, decided the Committee in favour of Maha Iluppalama, where analysis showed the soil to be good (*cf.* tables attached * and report by chemist), and preliminary experiment with an acre of land had shown that tobacco grew excellently well.

Mr. Cowan, the expert engaged, having a thorough knowledge of Sumatra methods, Sumatra and Java tobaccos were decided upon, and the experiment was carried out in 1910.

The growth of the tobacco was admirable, and those who saw the fields during the growing season will be the first to admit that nothing could have been finer. Unfortunately the area (20 acres) was not sufficient to give enough material for a good cure, and the tobacco

* Not printed.

in the end was insufficiently fermented, selling only at 35 pfennigs a kilo, instead of 75-80, the price of average Sumatra. Mr. Cowan is certain that had there been enough it would have cured equal to average Sumatra.

In actual fact the return was one quarter the cost. Assuming the price of average Sumatra, it would have been one-half of the cost, and there remains for consideration the question whether the cost can be reduced or the yield increased to transform this deficit into a surplus. There is fair prospect, considering that the coolies were untrained, and that great care was exercised in taking crop to leave poorer leaves behind, that it can, but there is obviously no certainty of an immediate success in tobacco growing in Ceylon for the European market.

It will be necessary now to start, under expert supervision, a long series of experiments with Sumatra (and other) tobaccos to determine the best growing season, the best methods of cultivation and curing, and so on. At the same time it will probably prove necessary to select seed very carefully, to get a race of tobacco suited to Ceylon which will breed true locally. This will be a matter of great expense and trouble, and I do not think much can be done without an expenditure of at least Rs. 25,000 a year for the next four or five years or more. The work should be started soon, to take advantage of the facts that there exist at Maha Iluppalama curing sheds, trained coolies, &c.

In view of these facts, the Committee does not consider it advisable to continue the tobacco experiment upon the same lines as hitherto, viz., upon a commercial basis, as it is of opinion that such an experiment must end in failure, owing to the high cost of growing the tobacco and the low price realized from the sale thereof. It considers that such an undertaking is altogether too large for the Agricultural Society, having in view the amount of funds at its disposal.

The Committee, however, are of opinion that it would be a pity to cease the experiment in tobacco growing in the Colony, and would express the hope that it may be taken up by the new Department of Agriculture; also that an expert may be appointed with a view to ascertaining the best kind of tobacco which can be grown profitably in the Island, and in what districts such can be grown; also that the expert should train a few officers in scientific tobacco cultivation, who may be in a position, when his agreement terminates, to carry on the cultivation upon a commercial basis, and act as instructors for the future.

JOHN C. WILLIS.

September 12, 1911.

REPORT BY THE GOVERNMENT AGRICULTURAL CHEMIST.

The Director, Royal Botanic Gardens.

SIR,—Herewith my report on samples of soil marked A, B. C, D, E, and F from Maha Iluppalama Experiment Station.

The soils are similar in appearance and chemical and physical composition. They are all dark gray sandy loams of a hard lumpy nature, which would set hard after rain and trampling by coolies. This tendency could be rectified by mulching as much vegetable refuse as possible into the soils and the aid of continual forking or ploughing, thus opening up the soils and keeping them in good tilth. Extra draining might also improve the soils, and liming would be advantageous, although the soils all contain over half per cent. of lime and no sourness is present, yet for the sake of physical condition it would be advisable to broadcast 500 lb. of burnt lime per acre.

In mineral plant food the soils are well supplied with lime and magnesia, and to a lesser extent in potash; the phosphoric acid is rather deficient, especially in sample B, while in E the deficiency is not so great as in the other samples. The humus and nitrogen are poor in all the samples, but there is a slightly better proportion in D and F.

A. BRUCE,

Acting Government Chemist.

June 12, 1911,

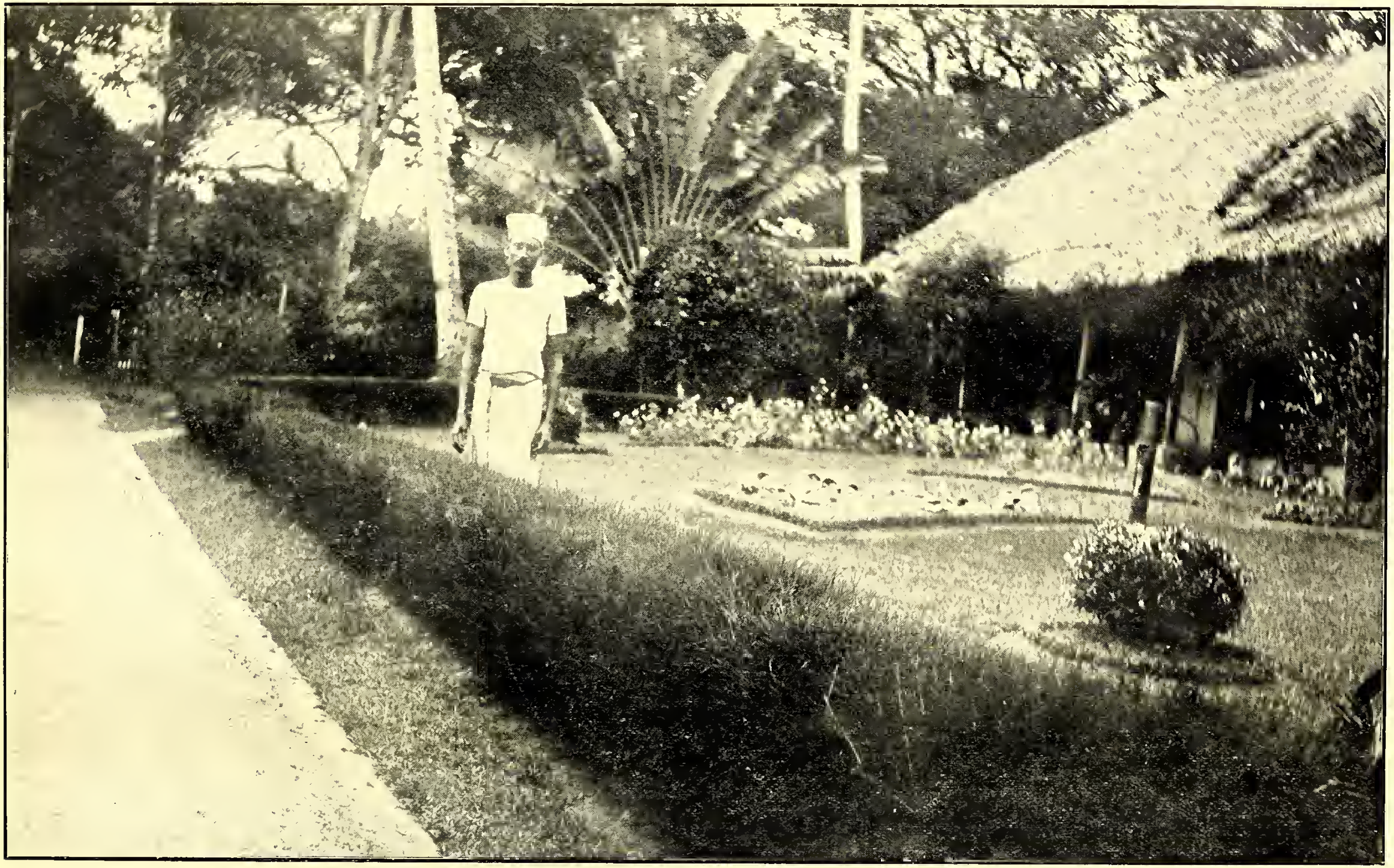
REMARKS ON THE EXPERIMENT.

BY THE SUPERINTENDENT, EXPERIMENT STATION, MAHA ILUPPALAMA.

The Director, Royal Botanic Gardens.

SIR,—If it has been decided that the Agricultural Society's experiment in growing tobacco from the commercial point of view be discontinued, I wish to propose that tobacco growing be continued this coming season as part of the programme of work to be undertaken by the Experiment Station, Maha Iluppalama.

The curing shed, which was recently overhauled and repaired for dealing with the present crop of tobacco, which was taken over by this Department on the work being suspended by the Agricultural Society, is now good for at least another season's crop.



CASUARINA HEDGE AT THE GOVERNMENT STOCK GARDEN.

I have been engaged in preserving under bag seed from selected plants of this year's crop.

I put forward the following points in favour of continuing the work :—

(1) We should by the end of the season possess tobacco seed—so-called Sumatra—partially acclimatized, at any rate to the extent of three seasons' growth in Ceylon.

(2) We should, as a result of two seasons' selection of seed under bag, have made some progress towards obtaining a fixed local type of Sumatra plant.

(3) We should find out what quality of leaf could be produced, when the crop is grown in the season of the year most suitable for the production of thin leaves.

(4) A detailed account of expenses could be kept, and it would be instructive to compare the cost of labour when the crop is grown under irrigation as hitherto, with the cost of labour when the crop is not grown under irrigation, as would be done in the proposed trial.

If undertaken, the experiments would of necessity not be on a very large scale ; however, some 25 acres could be dealt with.

It may be put forward that we should be no better off than in the first trials, as we should be unable to ferment the tobacco. I think we should be distinctly better off. For one thing the leaf, if it is finer and thinner than last year—and it is expected it will be—would not require a very high temperature. Further, the greater humidity of the atmosphere which we should be experiencing at the time when fermentation would be going on ought to enable us to obtain a sufficiently high temperature.

It must be remembered that last year's crop was undergoing the process of fermentation at the season of the year when the atmosphere is as dry as possible, when a searching wind is continually blowing, and when there is practically no dew at nights, with the result that it was impossible to put the cured leaf into the staple in a sufficiently damp condition for any sort of fermentation to be set up.

I would suggest also that plots be grown, of about half an acre each, of other kinds of tobacco, if seed can be obtained, including some cigar filler tobacco, such as Cuban. Observations could be made as to the suitability or otherwise of the soil and climate for the proper growth of such tobaccos. Seed could be preserved under bag, so that in the event of any variety showing marked good qualities in the green leaf, a trial on a large scale could be made with the tobacco later on.

Now the crux of the whole situation is whether the Agricultural Society would be prepared to contribute, say, Rs. 400 monthly towards the working expenses. The labour vote of the Experiment Station is quite inadequate for me to attempt to carry out experiments with a crop requiring such constant attention as tobacco, while at the same time carrying on trials in connection with cotton, paddy, rubber, soya bean, &c.

If you approve of these suggestions, I hope you will use your influence towards obtaining the necessary funds. As the time is now imminent when a start must be made with the work, I hope a favourable decision will be speedily arrived at.

A number of my former tobacco coolies are now in Jaffna, and they are only waiting to hear that tobacco cultivation is to be continued to come back with fresh coolies.

G. HARBORD,
Supdt., Experiment Station.
Maha Iluppalama, September, 1911.

CASUARINA HEDGE.

The illustration in the present issue shows a hedge of *Casuarina equisetifolia* at the Government Stock Garden. The plants are about five years old, and have been dwarfed by continuous trimming, so that the hedge has not been allowed to exceed 2 feet in height. The seeds of the Casuarina are very minute in size, and need very careful propagation. They should be raised in shallow boxes, and when the seeds have become established, they should be picked out and put about an inch apart into fresh boxes before being finally transplanted to their permanent situations, where they should be planted a foot or 15 inches apart. Care should be taken not to allow the plants to become spindly, and bottom shoots should be encouraged by early trimming, so that in a year or so a dense growth with a surface like a scrubbing brush may be secured. The Casuarina does well along the seaborde, and those who have visited Madras will recall the hedge along the Marina quite close the sea.

A pound of Casuarina seed (which goes a long way) can be sold for Rs. 2 or Rs. 2·50. The photograph for the illustration is by Mr. H. F. Macmillan, Curator of the Royal Botanic Gardens.

A DICTIONARY OF TERMS USED IN AGRICULTURE, BOTANY, CHEMISTRY, AND ALLIED SCIENCES:

For the use of Planters and Others.

By J. C. Willis and M. Willis.

(*Continued from page 333.*)

Dust ... A grade of tea
Eagle wood ... Aquilaria Agallocha
Earth nut ... Ground nut
Ebracteate ... Without bracts
Echinate ... With spines
Echinulate ... With little spines
Eciliate ... Without cilia
Effuse ... Expanded
Eggfruit ... Brinjal
Eglandular ... Without glands
Ekel ... Vein of palm-leaf, esp. coconut
Ela ... Artificial water course
Elachi ... (Hind.) Cardamom
Electrolyte ... Product of decomposition by electric current
Elephant creeper Argyreia speciosa
Elevator ... Lift; grain storage building
Ellipsoid ... Longer than broad, with rounded ends
Emarginate ... Notched
Emblic myrobalan ... Phyllanthus Emblica
Embryo ... Young plant contained in the seed
Emulsion ... Oil turned milky by action of some other substance
Endemic ... Occurring solely in one place, island or mountain
Endive ... Cichorium Endivia
Endocarp ... Inner portion of the wall of a fruit
Endosperm ... Food within the seed for the use of the young plant
Ensiform ... Sword shaped
Ensilage ... Green fodder preserved under pressure in a pit
Entire ... Without notches
Entomologist ... A student of insects and diseases caused by them
Entomology ... Science dealing with insects
Enzyme ... An unorganised or soluble ferment
Epaleate ... Without paleæ
Epicalyx ... Bracteoles resembling a calyx just below a flower
Epicarp ... Outer layer of the wall of a fruit
Epichil ... End of orchid labellum when distinct from base
Epidemic (disease) One breaking out occasionally
Epidermis ... Outer covering layer composed of cells
Epigynous (flower) Flower in which the ovary is immersed in and united to the hollow receptacle, only the styles being free
Epipetalous ... Stamens adherent to the corolla
Epiphyllous ... Stamens adherent to perianth
Epiphyte (Epiphytic) ... Plants clinging to other plants for support but not parasitic on them and not usually attached to the soil
Equitant ... Leaves folded lengthwise and the older overlapping the younger
Erandu ... Castor oil, Ricinus
Erectopatent ... Erect and widely open
Eri silk worm ... Attacus ricini
Erose ... Slightly irregularly toothed
Essential oil ... An oil obtainable by distillation
Essential organs... Stamens and carpels
Estate ... An area of 20 acres or more, cultivated at least partly with hired labour
Estrophiolate ... With no strophiole
Evanescent ... Visible for only a short time
European silkworm ... Bombyx Mori
Everted ... Projecting outwards
Exalbuminous ... Without endosperm
Excavate ... Hollowed out
Excentric ... Out of the centre
Exfoliating ... Shedding leaves
Exotic ... Foreign
Experiment Station ... A large piece of land devoted to experiments with important cultivated crops

Explanate ... Spread out flat
Exserted ... Protruding
Exstipulate ... Without stipules
Extra-axillary ... Not in the axils
Extractives ... Substances obtained from a plant by special treatment, such as steam distillation, natural evaporation, boiling, etc.
Extrorse ... Opening away from the centre of the flower
Facultative ... Incidental
Faggot worm ... *cf.* Bag-worm
Falcate ... Sickle-shaped
Fall ... Autumn (American)
Fallow ... Not bearing crops for a season
Fan palm ... Palmyra, Sabal, Thrinax, &c., &c.
Farina ... Starch in seed, becoming floury when crushed
Farinaceous ... Containing starch
Farinose ... Covered with a mealiness.
Fasciation ... Union of stems and branches forming a flat structure
Fascicle ... Tuft of lateral branches
Fasciculate ... With small fascicles
Fastigiate ... Many branches parallel to stem
Fecula ... Starch
Fenugreek ... Trigonella Fœnum græcum
Ferrugineous ... Containing iron, Rust-coloured
Ferment ... A body which changes the chemical composition of substances in contact with it, without undergoing any apparent change of its own
Fermentation ... Change of chemical composition due to action of bacteria or catalytic agents
Fermenting ... In tea, tobacco, &c., placing the damp leaf to undergo a process of heating by fermentation
Fern ... A vascular plant which does not produce seeds but reproduces by aid of minute spores borne on the backs of the leaves
Fertilisation ... *Plants.*—The union between the male nucleus of the pollen tube and the ovum of embryo sac. *Animals.*—Union between ovum and spermatozoon.
Fertilizer (American) ... Manure
Fever nettle ... Laportea crenulata, &c.
Fever nut ... Cæsalpinia bonducella
Fibre ... Supporting tissue of plants remaining after the decay of softer parts
Fibrillæ ... Small fibres
Fibrillose ... With small fibres.
Fibrous (root) ... A root consisting of tufts of uniform length as in grasses
Filament ... The stalk of a stamen
Filiform ... Thread-like
Filler ... The leaf placed in the centre of a cigar
Filmy ferns ... Hymenophyllaceæ
Fimbriate ... Fringed
Fine plucking (tea) ... Taking the bud and two young leaves below it
Finger and toe disease ... A disease of cabbages, turnips, and other Cruciferæ, caused by the fungus Plasmodiophora Brassicæ.
Firing (tea) ... Drying the fermented leaf
Fission ... Division by splitting
Flabellate, Flabelliform ... Fan-shaped
Flaccid ... Soft and easily bent
Flagellum ... Whip-like outgrowth
Flagelliferous ... Bearing flagella
Flamboyante ... Poinciana regia
Flame tree ... Nuytsia (Australia), Flamboyante, &c.
Flexuose ... Zig-zag
Flexure ... Bend
Floccose .. Bearing tufts of soft hair
Flocculent ... Diminutive of last
Flore pleno ... Double flowered
Florida velvet bean ... Mucuna pruriens
Floss ... Fine fibre
Flower fence ... Cæsalpinia pulcherrima
Flush, flushing ... The appearance of young shoots upon a tea bush
Foliaceous ... Leaf-like. Leaf-bearing
Follicle ... Fruit consisting of one carpel, splitting down one side only
Foot ... Structure fastening the fertilised egg cell to the prothallus. (In orchids) projection at foot of column

Foot and mouth disease ... A troublesome disease of animals, whose nature is not fully understood. Treatment usually by slaughtering
Forage ... Food for cattle, horses, etc
Forastero ... A variety of cacao
Fornicate ... Arched
Foveolate ... Covered with small pits
Foxy ... (Coffee berries) drying to a reddish colour
Frangipani ... Plumeria acutifolia
Free ... Not united to another organ
French bean ... Phaseolus vulgaris
French Garden ... Cultivation under glass, with heavy manuring
Friable ... Easily powdered
Fruit ... The ovary, stimulated to further growth by fertilisation, enclosing the ripe seeds
Fugacious ... Falling early
Fulvous ... Tawny
Fumigation ... Treatment to destroy fungous, bacterial, or insect diseases
Fungicide ... Substance destroying fungi
Fungus ... A non-vascular plant which contains no green colouring matter and does not produce seeds
Funicle ... Stalk of ovule
Furfuraceous ... With soft scales
Fusiform ... Spindle shape
Fuzz ... The fine hair left on a cotton seed after ginning
Gahu (Ind.) ... Wheat
Galingale, galinga Kæmpferia galanga and Alpinia galanga
Gall ... Abnormal growth on plants usually caused by insects
Gall-nuts ... Myrobalans
Gambier ... Uncaria Gambir
Gamboge ... Garcinia Morella, &c.
Gamopetalous ... With united petals
Gamophyllous ... With united perianth segments
Gamosepalous ... With united sepals
Gang plough ... Plough making more than one furrow
Ganja ... Female flowering tops of hemp packed together
Garjan oil ... Dipterocarpus sp.
Garlic ... Allium sativum
Gehun (Ind.) ... Wheat
General ... The opposite of partial
Genus ... The next larger group than species of related forms, *e.g.*, the cabbage-turnip-mustard genus
Geniculate ... Bent sharply, like a knee
Geranium oil ... Oil of Cymbopogon Martini
Germinate ... Sprout, begin to grow (of seeds).
Getah (Malay) ... Gutta (percha)
Ghat ... Landing place; path of descent to a river; mountain pass
Ghee ... Boiled butter
Gherkin .. Young cucumber
Giant bamboo ... Dendrocalamus giganteus
Gibbous ... With projecting broad pouch
Gingelly ... Sesamum indicum
Ginger ... Zingiber officinale
Gingili ... Sesamum indicum
Gins ... Machine to separate the seeds from the cotton fibre
Girdle ... To take off a complete ring of bark
Glabrate ... Without hairs
Glabrescent ... Almost hairless
Glabrous ... Hairless
Gland ... Organ secreting fluid
Glaucescent ... Becoming sea-green, or more or less sea-green
Glaucous ... With waxy, bloom, or sea green
Globose ... Almost spherical
Glochidiate ... Provided with curious barbed hairs
Glucoside ... Substance giving rise to glucose on decomposition
Glumaceous ... Glume-like
Glume ... Scaly leaves protecting flowers of grasses and sedges
Gluten ... The nitrogenous portion of wheat, &c.
Gneiss ... A granite-like rock with the materials arranged in fairly parallel layers
Goa bean ... Psophocarpus tetragonolobus
Godown ... Out-house
Gold mohur tree Cæsalpinia pulcherrima
Golden tips ... Tea made from leaf buds
Gomuti palm ... Arenga saccharifera
Gondal fluid .. See Watt and Mann, Pests and Blights of the Tea Plant, p. 344

Gonidiospore ... Asexually produced spore of fungi
Goradu ... Yam.
Gordon plant ... Euryale ferox
Gormandiser ... Sucker
Gourd ... Cucurbita maxima
Gourmands ... Suckers
Gow ... 4 miles
Goyiya ... Peasant proprietor
Grade ... A particular quality
Grafting ... Inserting a short branch of one plant into a slit cut for it in another, so that the two shall grow together
Grains of paradise ... Amomum Melegueta
Gramme ... A metric weight = $15\frac{1}{2}$ grains
Granadilla ... Passiflora quadrangularis
Granular, Granulate ... Composed of grains
Granulator ... Machine for powdering
Grass cloth ... Ramie, Boehmeria nivea
Great Millet ... Sorghum vulgare
Green bug ... Lecarium viride (sometimes also the stink-bug Nezara viridula)
Green fly ... Aphides
Green heart ... Nicandra Rodiœi
Green manure ... Manure formed from green plants belonging to the natural order Leguminosæ
Grey blight ... Blight of tea, characterised by grey patches on the leaves
Ground nut ... Arachis hypogæa
Grubber ... Cultivator
Grugru palm ... Acrocomia fusiformis
Guaco ... Mikania guaco
Guano ... Manure from excrement of sea birds
Guarana ... Paullinia Cupana
Guava ... Psidium guajava, &c.
Guayule ... Parthenium argentatum
Guinea corn ... Sorghum vulgare
Guinea grass ... Panicum maximum
Guinea yam ... Dioscorea aculeata
Gulab (Hind.) ... Rose
Gum ... Substance formed by disintegration of parts of a plant, swelling and often dissolving in water, and insoluble in alcohol or ether
Gummosis ... A disease characterised by the formation of a gummy excretion
Gum resin ... Substances formed by secretion or disintegration in plants and consisting of a mixture of gum and resin
Gum-tree ... Nyssa, (West Ind. Sapium)
Gumuti ... Arenga saccharifera
Gunny bag ... Bag made of jute fibre
Gunpowder ... A grade of green tea
Gur, gul (Ind.) ... Jaggery
Gutta percha ... Substance derived from the latex of Sapotaceæ, harder than rubber when cool, not extensible, and softening with heat. Obtained from Dichopsis, Mimusops, Palaquium, Payena, etc.
Gynœcium ... The carpels, considered together
Gynophore ... Elongated portion of receptacle bearing the carpels
Habitat ... Situation inhabited by, and suitable to, a plant
Hal ... A plough
Halfspiral ... Method of tapping rubber by cutting spirals that only go half round the tree
Hard fine ... The best quality of Para rubber
Haricot bean ... See French bean
Hashish ... An intoxicating liquor made from hemp, Cannabis sativa
Hastate ... With two pointed lobes sticking out horizontally at the base
Haulm ... Stem
Head ... Collection of sessile flowers on a common receptacle, as in daisy
Heart-wood ... Older wood no longer used for passage of sap, and often coloured
Hectare ... 100 metres square, approximately 2·45 acres
Helicoid ... Curved like a snail's shell
Helopeltis ... Mosquito blight (pest of tea and cacao)
Hemileia ... Coffee leaf disease
Hemp ... Cannabis sativa
Hemp, Ambari or Deccan ... Hibiscus cannabinus
Hemp, Bombay.. Crotalaria juncea

(*Continued.*)

MARKET RATES FOR TROPICAL PRODUCTS.

(From Lewis & Peat's Monthly Prices Current, London, 13th September, 1911.)

	QUALITY.	QUOTATIONS.
ALOES, Socotrine cwt.	Fair to fine ...	70s a 75s
Zanzibar & Hepatic ,,	Common to good ..	40s a 72s 6d
ARROWROOT (Natal) lb.	Fair to fine ..	8d a 9d
BEES' WAX, cwt.		
Zanzibar Yellow ,,	Slightly drossy to fair ..	£6 12s 6d a £6 15s
East Indian, bleached ,,	Fair to good	£7 12/6 a £7 17s 6d
,, unbleached ,,	Dark to good genuine ..	£5 15s a £6 7s 6d
Madagascar ,,	Dark to good palish	£6 10s a £6 17s 6d
CAMPHOR, Japan ,,	Refined	1s [illegible]¾d a 1s [illegible]d
China ,,	Fair average quality ...	150s nom.
CARDAMOMS, Tuticorin	Good to fine bold	2s 6d a [illegible]s 10d
	Middling lean	2s a [illegible]s 3d
Malabar, Tellicherry	Good to fine bold ..	2s 4d a 2s 10d
Calicut	Brownish ..	1s 10d a 2s 2d
Mangalore ,,	Med brown to fair bold	2s 5d a 3s 4d
Ceylon, Mysore ,,	Small fair to fine plump	1s 10d a 3s 4d
Malabar ..	Fair to good ..	1s 8d a 1s 10d
Seeds, E. I. & Ceylon ,,	Fair to good ..	2s 1d a 2s 3d
Ceylon Long Wild ,,	Shelly to good ..	6d a 1s 6d
CASTOR OIL, Calcutta ,,	Good 2nds .	3½d a 3⅝d
CHILLIES, Zanzibar cwt.	Dull to fine bright ...	40s a 45s
CINCHONA BARK.—lb. Ceylon	Crown, Renewed	3⅜d a 7d
	Org. Stem	2d a 6d
	Red Org. Stem	1¾d a 4¼d
	Renewed	3d a 5¼d
	Root	1⅞d a 4d
CINNAMON, Ceylon 1sts per lb.	Good to fine quill	6½d a 1s 5d
2nds	,, ,,	5¾d a 1s 4d
3rds	,, ,,	5d a 1s
4ths	,, ,,	4½d a 8½d
Chips, &c..	Fair to fine bold	2¼d a 3d
CLOVES, Penang lb.	Dull to fine bright pkd.	1[illegible]d a 1s 2d
Amboyna ..	Dull to fine	9d a 10d
Ceylon ..	,, ,,	9d a 10d
Zanzibar	Fair and fine bright	8d a 8¼d
Stems ..	Fair	3d
COFFEE		
Ceylon Plantation cwt.	Medium to bold	70s a 113s
Native	Good ordinary	
Liberian ,,	Fair to bold	62s a 68s
COCOA, Ceylon Plant. ,,	Special Marks	75s a 85s 6d
	Red to good	65s a 73s
Native Estate ,,	Ordinary to red	43s a 64s
Java and Celebes ,,	Small to good red	25s a 77s
COLOMBO ROOT ,,	Middling to good	12s a 17s
CROTON SEEDS, sift. cwt.	Dull to fair	70s a 75s
CUBEBS ,, ,,	Ord. stalky to good	160s a 170s
GINGER, Bengal, rough ,,	Fair	35s nom.
Calicut, Cut A ,,	Small to fine bold	80s a 85s
B & C ,,	Small and medium	60s a 70s
Cochin Rough ,,	Common to fine bold	40s a 45s
	Small and D's	40s
Japan ,,	Unsplit	37s
GUM AMMONIACUM ,,	Ord. blocky to fair clean	40s a 67s 6d
ANIMI, Zanzibar	Pale and amber, str. srts	£15 a £16
	,, ,, little red	£12 a £14
	Bean and Pea size ditto	75s a £12 10s
	Fair to good red sorts	£7 a £10
	Med. & bold glassy sorts	£5 a £7
Madagascar ,,	Fair to good palish ...	£4 a £8 15s
	,, ,, red ...	£4 a £7 10s
ARABIC E. I. & Aden ,,	Ordinary to good pale	30s a 37s 6d nom.
Turkey sorts ,,		49s a 65s
Ghatti ,,	Sorts to fine pale ...	21/6 a 42s 6d nom.
Kurrachee ,,	Reddish to good pale ...	20s a 35s ,,
Madras ,,	Dark to fine pale ...	20s a 32s 6d ,,
ASSAFŒTIDA ,,	Clean fr. to gd. almonds	£18 10s a £21 5s
	com. stony to good block	25s a £15
KINO	Fair to fine bright	9d a 1s
MYRRH, Aden sorts cwt	Middling to good	55s a 60s
Somali ,,	,, ,,	50s a 52s 6d
OLIBANUM, drop ,,	Good to fine white	45s a 50s
	Middling to fair	35s a 40s
pickings ,,	Low to good pale	12s 6d a 27s 6d
siftings ,,	Slightly foul to fine	20s a 22s 6d
INDIA RUBBER lb.	Fine Para bis. & sheets	5s 4d
	,, Ceara ,, ,,	5s
Ceylon, Straits, Malay Straits, etc.	Crepe ordinary to fine..	5s 3d a 5s 6d
	Fine Block ..	5s 6d
	Scrap fair to fine ..	4s 4d a 4s 7d
Assam	Plantation ..	4s 2d
	Fair II to ord. red No. 1	3s a [illegible]d 9d
Rangoon	,, ,,	2s [illegible]d a 3s
INDIARUBBER. *(Contd.)*		
Borneo	Common to good	1s 9d a 2s 9d
Java	Good to fine red ..	2s 9d a 3s
Penang	Low white to prime red	1s 8d a 2s 6d
Mozambique	Fair to fine red ball ...	3s 6d a 4s 2d
	Sausage, fair to good ..	3s 6d a 4s 1d
Nyassaland	Fair to fine ball ...	3s 4d a 3s 11d
Madagascar	Fr to fine pinky & white	3s a 3s 4d
	Majunga & blk coated ..	2s 1d a 2s 6d
	Niggers, low to good ..	8d a 2s 10d
New Guinea	Ordinary to fine ball ..	2s 6d a 3s 6d
INDIGO, E.I. Bengal	Shipping mid to gd violet	3s 2d a 3s 8d
	Consuming mid. to gd,	2s 8d a 3s 1d
	Ordinary to middling	2s 5d a 2s 8d
	Oudes Middling to fine	2s 6d a 2/8 nom.
	Mid. to good Kurpah	2s 2d a 2s 6d
	Low to ordinary	1s 6d a 2s
	Mid. to fine Madras	None here
MACE, Bombay & Penang per lb.	Pale reddish to fine	2s 3d a 2s 6d
	Ordinary to fair	2s a 2s 2d
Java	,, ,, good pale	2s a 2s 4d
Bombay	Wild	4d a 5d
MYRABOLANES, cwt	UG and Coconada	4s 6d a 5s
Bombay ,,	Jubblepore	4s 6d a 6s 3d
	Bhimlies	5s a 6s 6d
	Rhajpore, &c.	4s 6d a 5s 9d
Bengal ,,	Calcutta	3s 9d a 4s 3d
NUTMEGS— lb.	64's to 57's	10d a 1s
Singapore & Penang ,,	80's	6½d a 7d
	110's	5¼d
NUTS, ARECA cwt.	Ordinary to fair fresh	15s a 17s 6d
NUX VOMICA, Cochin per cwt.	Ordinary to good	9s 6d a 11s
Bengal	,, ,,	7s 6d a 8s 6d
Madras	,, ,,	8s a 9d
OIL OF ANISEED ,,	Fair merchantable	5s
CASSIA ,,	According to analysis	3s 4d a 3s 7d
LEMONGRASS ,,	Good flavour & colour	4½d
NUTMEG ,,	Dingy to white	1½d a 1¾d
CINNAMON ,,	Ordinary to fair sweet	2⅛d a 1s 4d
CITRONELLE ,,	Bright & good flavour	1s
ORCHELLA WEED—cwt		
Ceylon ,,	Fair ...	10s
Madagascar ,,	Fair ...	10s
PEPPER—(Black) lb.		
Alleppy & Tellicherry	Fair ...	5¾d
Ceylon ,, ,,	,, to fine bold heavy ..	5½d a 6d
Singapore ...	Fair	5¼d
Acheen & W. C. Penang	Dull to fine	5⅛d a 6d
(White) Singapore ,,	Fair to fine	8d a 9d
Siam ,,	Fair	7¾d
Penang ,,	Fair	7⅛d
Muntok ,,	Fair	8¾d
RHUBARB, Shenzi ..	Ordinary to good ..	1s 2d a 2s 6d
Canton ..	Ordinary to good ..	10d a 1s
High Dried ..	Fair to fine flat ...	8½d a 9½d
	Dark to fair round ..	5½d a 7½d
SAGO, Pearl, large ..	Fair to fine	18s a 19s
medium ..	,, ,,	17s a 18s 6d
small ...	,, ,,	14s a 15s
SEEDLAC cwt.	Ordinary to gd. soluble	52s 6d a 72s 6d
SENNA, Tinnevelly lb.	Good to fine bold green	5d a 7d
	Fair greenish	2¾d a 4½d
	Common specky and small	1½d a 2¼d
SHELLS, M. o'PEARL—		
Egyptian cwt.	Small to bold ...	77s 6d a 165s
Bombay ,,	,, ,, ...	45s a 167s 6d
Mergui ,,	,, ,, ..	£10 12/6 a 14 2/6
Manilla ,,	Fair to good ..	£8 a £14 2/6
Banda ,,	Sorts	21s 6d a 29s 6d
TAMARINDS, Calcutta... per cwt.	Mid. to fine bl'k not stony	10s a 12s [nom.
Madras	Stony and inferior ..	4s a 5s
TORTOISESHELL—		
Zanzibar, & Bombay lb.	Small to bold ..	11s 6d a 28s
	Pickings –	8s 6d a 21s
TURMERIC, Bengal cwt.	Fair ..	22s 6d
Madras ,,	Finger fair to fine bold [bright	23s a 25s
Do. ,,	Bulbs	18s
Cochin ,,	Finger ..	18s
	Bulbs ...	14s
VANILLOES— lb.		
Mauritius ... 1sts	Gd crystallized 3½ a 8½ in	14s a 19s
Madagascar ... 2nds	Foxy & reddish 3½ a ,,	13s a 15s 6d
Seychelles ... 3rds	Lean and inferior ...	12s 6d a 13s 6d
VERMILLION ..	Fine, pure, bright ...	3s
WAX, Japan, squares	Good white hard ...	40s

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AN IMPROVED "HATMAKING" INDUSTRY FOR THE SINHALESE.

A good many years ago a Sydney merchant, seeing the "fishermen big straw hat" made and sold by Sinhalese women from Cotta, was so taken with them, that he left 30 sovereigns (£30 sterling) to get a consignment shipped to his firm for distribution to retailers, to shepherds and cattlemen in "the bush"! This was a Godsend to poor people in Cotta in a year of poor crops and dear rice. The Church Missionary, who took charge, had enough for a number of families for months! The hats were duly shipped and distributed and sold; but there were no repeat orders and so the Cotta hats evidently did not suit Australian shepherds. But cannot the Sinhalese villagers do something better? Here is a note and extract from our correspondent in the Philippines:—

"This may be interesting for the *T.A.* You have probably got the same palm in Ceylon, that is used here, and might start a new industry in Ceylon.

"If you send a reporter here in February for the Carnival, he will see native girls making hats in the Carnival grounds. I think the Carnival Association pays the hotel expenses of Pressmen from other countries."

The extract is from a Manila paper:—

HATMAKING IS GROWING INDUSTRY.

EXPORTS OF HATS TO THE UNITED STATES SHOW BIG INCREASE.

A new industry, of which little is known outside of commercial circles, is growing in the Philippines in the making of what are commonly termed *bamboo hats*. The customs export fignres for the fiscal year of 1911 show an increase of over sixty per cent to the United States alone, but with a small increase of ten per cent in the revenue.

Members of the local hat exporting firms state that the reason for the small increase in revenue compared with the large increase in the quantity exported to the States, is the lack of increased production of the finer grades for which experts are necessary.

The coarser grades are in great demand among the working class, farmers, and the negroes of southern states owing to their cheapness, their selling price being about twenty five cents gold, and the Filipino workmen, recognising that they can make as much revenue from the cheaper hats, very seldom try to become experts in weaving the finer grades.

The chief article found in the local houses is called the kalasiao or pototan. It receives its name from the localities in which it is manufactured, Kalasiao, Pangasinan, and Pototan, Iloilo province. The fibre used is taken from the *unopened leaf of the buri palm* from which four different kinds of hats are produced, and is generally shaped over cardboard in the form of an ordinary straw hat. It is finished with two coats of a rice paste which gives it the pure white appearance.

The other two fibres from the buri palm are that taken from the leaf, making what is termed the buri hat, one of the cheapest, and that extracted from the inside or pith of the stem of the palm leaf from which is woven the buntal hat, Many other grades of hats are made from the fibre of the buri palm in various sections of the islands from which they receive their names, but correct classification is difficult as each hat-exporting firm has its own standard of classification.

The bamboo hat called Baliwag or Pulilan is made in the towns of those names from *bamboo splits* and its cheapness makes it the chief export hat of the Philippines. These hats can be made within a fow hours, but the finer grades, such as the large merry widow hats of the finest quality, consume several weeks in weaving, and bring an export price of $2 although when sold in the States the prices range from $10 to $50 and sometimes more. However the Philippine market supplies very few of these hats compared with the cheaper grades.

The export figures for the past fiscal year showed the quantity shipped from the islands to be 1,025,596 as against 621,475 exported last year while the increase in revenue was $17,638 gold. Of this amount over 700,000 hats were exported by Germann and Company, who are the leading exporters in the islands, while the remainder was divided between Manila Commercial Company, Fussell and Company, Max L. Tornow and Company, and several smaller exporters who sell in small lots.

Each firm has an expert for this department who is required to make a special study of the hat industry for a number of years before he is considered competent to judge between the different grades.

The Bureau of Education and the Bureau of Science are both working to bring the importance of this industry before the Filipino population, by issuing pamphlets on the different phases of the subject, and the bureau of education is establishing schools throughout the islands for the purpose of teaching the Filipinos the art of weaving straws and braids,

As to the palm mentioned and the industry we referred to the Secretary to the Agricultural Society, and Mr Drieberg writes :—

"The Buri palm about which you enquire is *Corypha Elata* very closely related to our talipot (*C. umbraculifera*) which I have no doubt can be employed exactly in the same way—if we only knew the art of hat making. I am returning the cutting, which does not give very much information, and am thinking of writing a paper on the subject for the Board when I can spare the time, as I have collected a good deal of material about it. It has struck me that it would be an excellentt hing if we could persnade the Philippine Government or some enterprising person out in Manila to undertake to send us an exhibit of hats and hat-making materiels for the All-Ceylon Exhibition 1912. If the exhibits could come in charge of a skillod hat maker who could show how it done, there will be much for Ceylon to learn from such a display. I should fancy there will be a good sale for hats and other articles if a collection is sent out."

Our Philippines' correspondent will be asked as to the proposal now made and whether sample hats and a worker can be got for Ceylon.

"FINANCIER'S" SPECIAL RUBBER COMMISSIONER IN CEYLON.

A BRIEF ACCOUNT OF HIS EASTERN TOUR.

Mr. E. L. Killick, the Special Commissioner of "The Financier," who has been inspecting the rubber plantations of the East, in the interests of his journal and is now on his way home in a hurried conversation with our representative said that he has been in all the Federated Malay States, Sumatra, Java, Dutch Borneo, and the Rhio Archipelago.

Exaggerated Estimates.

He has found that the future outputs of plantations have been greatly exaggerated by all estimate compilers. He considered it would be found that the big estimates they had worked up to for a single year would not be maintained indefinitely and regularly. There was a figure which might be kept pretty constant, but it was unquestionably lower that had been estimated. For this reason, he did not see how rubber could fail to keep at a very profitable figure for a good many years to come.

Little the Matter in the Industry.

There was certainly very little the matter with the industry. He had found nothing alarming in the way of disease anywhere. There was plenty of disease about, but it was being kept under. It did not seem likely to devastate whole areas, or anything approaching that kind of thing.

Castilloa a Failure.

The Castilloa rubber, which the Americans had expected a great deal from, he thought, would very shortly be shown to be practically a failure. There was quite a lot in Java and invariably it was unsatisfactory. There was difficulty in tapping, and a poor yield at that, and both Ceara and Ficus elastica were superior.

In the Rhio Archipelago.

There was a lot of rubber on some of the islands in the Rhio Archipelago. It has all Hevea, and growing well. The labour was Javanese indentured, and something about it was that the labourers could not bolt from the small islands.

Java Unsatisfactory.

Generally speaking rubber was growing well everywhere he had been, especially in Negri Sembilan and Selangor, where the growth was extraordinary. In Sumatra there were some very fine trees indeed, but Java did not compare at all with these places. There were one or two good places in Java, but as a general rule Java rubber would not do much, except in a few isolated cases.

Ceylon to the Fore.

Ceylon, in some points, such as management, organisation, and cultivation, compares very well with all other places, and the cost of production in Ceylon will always be low in comparison with a good many places. As for finished rubber, Mr Killick has seen nothing better anywhere than that from Ceylon's crack estates such as St. George's, Gikiyanakande, and Hanwella. Ceylon rubber was as good as any, he was quite satisfied of that.

The Drought.

The drought had played havoc with outputs in the Straits, and estimates would look silly, especially on the flat land, but that was nothing to be alarmed about. It was phenomenal. It might be good for the trees, and act as a sort of stimulant, making them yield better when the rain came.

High Standard and Tapping.

One thing he has been impressed with is the very high standard to which tapping has been brought. He thought that in future, as a result of the drought, planters would tap more carefully, and be more cautious in their estimates. He thought that in time there would be practically a revolution in the curing of rubber, for the last word did not seem to have been by any means reached.

RUBBER IN SEVERAL COUNTRIES.

A FEW PARTICULARS.

From numerous references to the resources of the Congo and Bolivia some interesting particulars are to be learned. In the Congo, during 1910, twelve large rubber plantations were either newly created or developed, and the experimental cultivation of the Hevea Brasiliensis, Funtumia Elastica, and Manihot Glaziovii species is being continued on a much enlarged scale on the plantations already in existence, and extensive new areas are about to be brought under cultivation. A number of the larger plantations are being devoted to the exclusive cultivation of Hevea, some 1,000 hectares having been planted. Funtumia Elastica, however, is the most common, and numbers some 3,461,000 trees, of which the greater part are reported to be thriving satisfactorily. The older trees, of seven to nine years, that have been tappod, have yielded a rubber of good quality that commanded a price in the Antwerp market ranging between 17f. and 20f. per kilo (Rs. 4·06 to Rs. 5·44 per lb.) The present yield of the six year old trees is said to be 100 grammes, which would represent a return of 137·75 lb. per hectare of 625 trees. Hevea is regarded by Government as a most promising plant, adaptable to the climatic conditions and inferiority of soil. Thirty thousand trees have been planted by Government, and seven extensive areas in the Bangala and Equator districts are to be brought under cultivation. All the available seeds in the Congo having been used up, further quantities are being imported from Ceylon. Considerable impetus is being given to the cultivation of Manihot Glaziovii, as, experimentally produced in the Congo, it has fetched 23f. per kilo in Antwerp, on account of its excellent quality. Experiments are also in progress with Castilloa, various Manihot and Ficus, and Euphorbia. Attention will also be given to the old rubber lianas, of which some 11,000,000 are known to exist. It is proposed to conduct the industry on scientific lines, such as those obtaining in Malaysia, particular attention being paid to the process of coagulation, washing and drying, for which the most approved plant will be acquired. Wild rubber is becoming scarce, or is in places difficult of access and unprofitable.

In Bolivia, the annual export value of rubber is estimated at 4,000,000 dollars. The exploitation of the rubber lands is regulated by law through an annual export tax. The principal areas lie in the north-east, near the Peruvian boundary; in the east, in the Province of Santa Cruz; and in the Acre and Beni territory, which is exceptionally rich in its yield. Two varieties of rubber plant are found in the district, the caucho, which has to be cut down in order to extract the sap, and the Hevea, which is merely tapped. In some cases the trees are tapped for a period of two years, and are then rested for a similar term. Other rubber trees are tapped for six years at a time, and then left untouched for a like period. The trees selected for tapping in this section are usually from 30 to 40 years of age, and are expected to yield for 20 years, after which they become useless.

In Panama, the soil is of marked fertility, and the climatic conditions of induce a luxuriant growth of tropical vegetation. Government is interesting itself in promoting the cultivation of coffee, cacao, coconuts, rubber, vanilla, and sugar-cane. Rubber is an export, the output coming from trees scattered natural in the forests. Coconuts form one of the staple exports, over 150,000 dollars worth being sent in 1910 to the United States.

ORANGES AND LEMON TREES PLANTED AMONG COCONUT PALMS.

Mexico, 4 de Setiembre de 1911.

Mess Tropical Agriculturist, Colombo, Ceilan.

DEAR SIRS,—We write to ask your opinion, on the following point:—

Would there be any objection to planting orange and lemon trees in between our coconut plantings. We plant our trees at 28 feet apart, on the triangle system.

Awaiting the favour of a reply, we are, yours very truly,

GRAVES Y GRAVES CIA.

A. R. MORREL,

Gerente.

We have had the above question placed before an experienced coconut planter and his answer is "I would recommend planting Orange or Lemon in the centre of four trees. Plant only one plant Quincunx—which will not do any harm to the coconut trees."

Another planter writes.

Oct. 25th.

DEAR SIR,—I regret I cannot give an opinion, based on practical experience, as to whether oranges and lemon trees would be a success planted among coconut palms placed 28 ft. apart on the triangle system.

If the oranges and lemon trees are put out in the field at the same time as the coconuts they would, I think, grow well together for some years but when the roots of the coconuts spread out and form a network in the soil the oranges will probably fall off in productiveness.

MacMillan in his hand-book of "Tropical Gardening" says with regard to the orange the distance for planting apart should be not less than 15 by 15 feet or 193 trees to the acre. In my opinion grafts would be best.—Yours faithfully,

COCONUT PLANTER.

[Much will depend on the quality of the soil and the climate as regards a well-distributed copious rainfall.—A. M. & J. F.]

RUBBER AND GUTTA PERCHA AND "THE TERPENES."

"A CHAPTER IN MODERN SYNTHETIC CHEMISTRY."

Sir William A. Tilden is, if we are not mistaken, about the oldest Chemist in England and the gentleman who, a few years ago when the British Association met at York, was good enough to forward a message to the RubberPlanters of Ceylon. The occasion and the message require explanation. In the Chemical Section of the Association, a paper on Synthetic Rubber was read and discussed at length, chiefly by young Chemists who seemed to be sanguine of being able very soon to turn out a good artificial rubber and prove it a commercial success. There was one senior member of keen intellectual features, grave and silent during the discussion, and, enquiring about his personality, we were told that was "Tilden," the oldest if not the ablest Chemist in England. Plucking up courage, we ventured, as the sitting ended, to make an introduction, how we were from Ceylon and to many of its planters we were afraid the views just expressed of an expectation of a cheap useful synthetic rubber, would spell great loss if not ruin, would he kindly say if he agreed with the sanguine opinions of his younger brethren. The purport of the answer (and message) of Mr. (now Sir W. A.) Tilden (given to Mr. J. Ferguson) can be indicated in this way:—Tell your friends in Ceylon that if I were a young man and a planter in your island that I would not hesitate to plant as many Rubber trees as I could manage without troubling myself about the laboratory experiments of the gentlemen who have spoken towards a synthetic rubber. That such a rubber might be managed to a useful degree, was quite possible in time; but whether the result could ever compete with the natural product in quality or *prices* was a different matter altogether. Evidently, some years ago—and no doubt still—Mr. now Sir William A. Tilden was not sanguine at all on the point. This little bit of experience at York in August, 1906, makes anything that falls from the pen of the veteran Chemist of much interest and in Murray's "Science Progress" we have a paper of his entitled "The Chemical History of the Terpenes," in which we find a few passages which bear on "synthetic rubber." First of all, Sir William opens his article as follows:—

The hydrocarbons known as the terpenes have long attracted the attention of chemists, on account of their wide diffusion in the vegetable kingdom and their frequent association with the odorous principles of plants, though it is only during the last thirty to forty years that systematic research has been rewarded with such a measure of success that it can be said that the properties and chemical constitution of all the more important members of the group are now as well understood as those of any group of carbon compounds.

The terpenes are highly interesting from two distinct points of view. As already mentioned they are important for commercial reasons not only on account of the use of some of them as solvents, especially the oils of turpentine in varnishes and paints, but they are characteristic and often predominant constituents of many essential oils used in medicine and perfumery. They have also been made the starting-point for the manufacture of certain substances—camphor and terpineol, for example, which are extensively used for such purposes.

But the history of the investigations by which the chemical constitution of many of the terpenes has at last been elucidated is specially interesting to the scientific chemist on account of the nature of the problems to be solved, the peculiar elusive transformations of the hydrocarbons and their derivatives and the ultimate success of these investigations, which provides a triumphant vindication of the principles which underlie modern synthetical chemistry. These principles concern not only the student of "organic" chemistry, for they are necessarily involved in general conceptions regarding the constitution of matter.

And after some fourteen pages mainly filled with technical details, we come upon the following:—

Isoprene heated alone in a sealed tube is converted into dipentene mixed with viscous products of its polymerisation. But if it is kept for some months or years under conditions which, except exclusion of air, have not been exactly determined, it passes spontaneously into a syrupy liquid which gradually deposits solid masses of rubber. Rubber is also formed when isoprene is heated with small quantities of acetic and other acids. This observation, made more than twenty years ago, has led to various attempts to employ isoprene as a practical source of rubber on a manufacturing scale.

When rubber or gutta-percha is destructively distilled it yields a mixture of hydrocarbons from which can be separated as chief products, isoprene and dipentene, originally called, caoutchine. It would appear from this that rubber is a compound, the formula of which is either $(C_{10}H_{16})_n$ or $(C_5H_8)_n$. From the direct conversion of isoprene into rubber the latter formula seems the more probable, especially as the temperature at which rubber decomposes is much below that at which depentene is broken down under the influence of heat. Indeed, it seems not improbable that the dipentene which accompanies isoprene in the distillation of rubber is a secondary result of the polymerisation of isoprene by heat. The condensation of isoprene into dipentene is easily represented as in the following formula where two molecules of isoperne are united by the dotted lines, the valencies adjusting themselves but without further change: * * *

To represent the condensation of isoprene into caoutchouc, Harries assumes the formation of an octadiene as the first product of the union of two molecules of isoprene, rubber consisting of multiples of this or $(C_{10}H_{16})_n$. * * *

Caoutchouc is a colloid of very high molecular weight and if it is assumed to be made up of a number of such groups united together, it is difficult to explain why rubber should break

down so easily in groups of C_5H_8 and why its combining capacity is represented by four atoms of bromine for every ten atoms of carbon.

Thiele's theory of partial valencies has been invoked by way of explanation but this is itself a subject of extremely doubtful character.

Other formulæ have been suggested but the whole question is one which requires much further investigation.

Finally, it may be remarked that the terpenes and their derivatives afford many examples of optically active compounds which, however, do not owe their activity to the presence of one or more asymmetric carbon atoms but rather to the asymmetry of the molecule as a whole. This phenomenon, however, is not peculiar to the terpenes and the question is too large for discussion on this occasion.

RUBBER EXHIBITION IN AMERICA.

October 10th, 1911.

DEAR SIR,—I extract the following from the *India Rubber World* of New York, in case it does not come your way. I think it is worthy of a place in your columns :—

" At no time in the history of the rubber trade could rubber manufacturers view a 50 per cent export duty on Brazilian rubber, and a restriction of the Acre product with greater calmness. Factory stocks have accumulated, reclaimed rubber is understood and manufactured on a greatly increased scale here and abroad, plastics, such as mineral rubber, are utilized the world over, and plantation receipts are constantly growing.

" If Brazil does as she plans, as she certainly has every right to do, rubber will undoubtedly be higher for a time. The result, however, will be a tremendous increase in planting, a further exploitation of the lesser rubber producers, the substitution of many plastics for rubber whereever it is possible, and the final disappearance from the market of all wild rubber, the cost of collection of which is above 50 cents a pound."

Since my stay in the United States, I find that plain rubber is coming into continued favour with the manufacturers in this country. The only thing is, they do not know enough about it. I have now arranged to hold an International Rubber and Allied Trades Exhibition under the auspices of the International Exposition Company, a body incorporated under the laws of the United States. Their building in the New Grand Central Palace, 46th to 47th Street and Lexington Avenue, New York City, is one of the most palatial buildings in the world.

The dates arranged are the 23rd of September, 1912, to October 3rd, 1912, and a very influential committee is now being formed, and my friend, Mr Henry C Pearson, the Editor of the "India Rubber World," will be the active Vice-President of the undertaking. Full particulars will be sent you in due course, and I trust the exposition will have your kind support.—Yours very truly,

A. STAINES MANDERS,
Organising Manager.

75, Chancery Lane, London, W.C.

SILK COTTON OR KAPOK.

The following particulars concerning the silk-cotton tree and the fibre and its uses are taken from the Bulletin of the Imperial Institute, Vol. IX (1911), p. 121.

Kapok is a fine fibrous material, somewhat resembling cotton, but weaker and more lustrous, derived from the tree known as Eriodendron anfractuosum which occurs in the Dutch East Indies, India, Ceylon, tropical Africa, the West Indies, Mexico and Central America. The fibres arise from the inner wall of the capsule and surround the seeds.

The kapok tree grows at the sea-level and up to an altitude of 3,000 or even 4,000 feet, but gives the best yield and quality of fibre when situated at less than 1,000 feet above the sea. It is said to flourish best on a porous, sandy clay soil, in a climate with a dry east monsoon, and to be capable of withstanding heavy rains and resisting long periods of drought.

The propagation of the tree can be easily effected by means of either cuttings or seed. In the latter case the seed is sown in nurseries, and is only lightly covered with earth. If the soil is poor, it is recommended that stable manure should be applied about ten days before sowing. The seed should be planted in rows at a distance of 10 to 12 inches. When the young plants are about 5 or 6 inches high they should be no longer shaded but exposed to the sun. If the plants do not obtain plenty of sunshine, they grow thin and lanky. The seedlings are planted out when from eight to twelve months old. In Java, kapok trees are commonly planted about 12 to 15 feet apart along the roads in the coffee and cacao plantations. When the trees are grown in special plantations, they should be placed about 18 feet apart (about 144 trees to the acre), for if planted more closely they soon interfere with one another. The trees commonly attain a height of 30 feet, but sometimes grow to 50 feet or even more.

Before transplanting, it is advisable to strip off all the leaves and to cut the stem down to a height of 1½ to 2 feet, and also to cut the chief roots so as to make stumps of them. If the top is not cut it will usually die down to the ground. The trees subsequently require very little attention, but the soil must be kept free from weeds.

During the early years of growth other plants can be cultivated between the young trees. In Java it is a common practice to grow pepper in this way, but it should not be planted before the kapok trees are three or four years old.

The trees begin to bear in the third or fourth year, but sometimes not till later. The crop is never very large until the sixth year. A large tree brings 1,000 to 1,500 fruits to maturity per annum, each of which contains about 0·7 to 1·2 grammes of dry fibre. Hence, on an average a well-developed tree may be expected to give an annual yield of ¾ to 1¼ kilogramme (or about 1½ to 2¾ lb.) of clean fibre.

The tree flowers in April or May, and the fruits mature at the end of October or in November. As the fruit ripens it becomes yellowish-brown and then begins to open. As soon as this point is reached, the fruits are gathered by means of long bamboo poles bearing small hooks at the upper ends. They are then

left on a clean floor, preferablv of cement, and exposed to the sun in order that they may ripen completely and open fully. The fibre and seeds are picked out of the capsules by women and children and dried in the sun for some days.

The seeds are usually removed from the fibre by beating with sticks, or by means of a simple machine. A special form of gin, resembling a cotton gin, has been recommended for the purpose but it must be remembered that in most cases the kapok is only a subsidiary product, and produced in small quantities, so that the provision of expensive machinery would no the remunerative.

The kapok is packed in bales by means of hydraulic or hand presses, but must not be compressed too severely, or its resilience will be impaired, and its value consequently diminished. Each bale weighs about 80lb. The number of bales exported from Java in recent years is as follows: 1907, 92,874; 1908, 109,852; 1909, 87,685.

The value of the total imports of kapok into the United Kingdom amounted to £23,752 in 1908, and to £27,645 in 1909.

An account of the properties and uses of the fibre has been given in this Bulletin (1905, p. 221.)

A German firm has recently discovered a method by means of which kapok can be spun either alone or in admixture with cotton (see this Bulletin, 1911. p. 70).

The market price of kapok has advanced during the last few months from 7d. to about 9d, per lb., and it is therefore possible that the collection and preparation of this fibre for export would prove a remunerative industry in certain British Colonies and Dependencies.

A GOOD WHITEWASH.

All whitewash, especially in the East, is not white, though it is supposed to be. We may leave on one side the lamentable grey and blue washes that, with criminally garish blues for door jambs and windows, seem to delight the primitive soul of the average Ceylonese house builder and decorator. Not only is whitewash not white enough, but it is, as a rule, rough and unpleasingly applied. Moreover, it suffers pitifully in the rain and at the, end of the monsoons assumes varied tints that are only less inartistic and unpleasing than the original outrage. Yet it would be easy to improve it, without having resort to expensive distempers. A little glue, a little care, and the change for the better would be marvellous. But there is a very simple method of improving the tone and quality of ordinary whitewash. It is the use of extract of ordinary cactus. The discovery was made in South America, where the common cactus is commoner even than in the tropical East. When travelling through the rural districts of Uruguay, says the American Consul at Monte Video, one's attention is attracted to the fine white colour of the farm buildings, even during the wet season. To obtain this neat effect a whitewash is used which is made with the sliced leaves of the common cactus, macerated in water for 24 hours, producing a solution of creamy consistency. To this lime is added and well mixed. When applied to any surface, be it wood, brick, iron, or other material, a beautiful pearly white appearance is produced which will endure for many years.

A METHOD OF TAPPING THE CEARA RUBBER TREE.

The *Agricultural Journal of the Mozambique Company*, Vol. I, p. 49, describes a mode of tapping the Ceara rubber tree (*Manihot Glaziovii*), which is known as the Lewa method, as follows :—

The tree is fit for tapping when the rough and papery outer bark has been removed. If this has not been recently done the surface may contain dirt conveyed up the tree by little ants, so it is therefore advisable for the tapper to carry a stiff scrubbing brush, for the purpose of cleaning the surface. The portion of the tree to be tapped is then painted over with a weak acid solution—acetic, citric, carbolic or fluoric acid. The juice of citrus fruits, such as limes, lemons or oranges, or seeds of the baobab tree soaked in water, will also serve the purpose; but clean solutions only should be employed, and absolute cleanliness practised throughout. In the portion to be tapped, almost point-like incisions should be made, and the latex oozes out and flows down, and coagulates in thin ribbons on the bark. These incisions should be made 4 inches apart, as each incision drains the latex from 1 inch to 2 inches in every direction from the wound An ordinary pruning knife is suitable, but every care must be taken that the incisions do not reach the cambium layer; a very narrow chisel, or a flattened bradawl, will also serve the purpose; but it is better to use a knife with a guard, to prevent the incisions from being made too deep. If the latex does not coagulate quickly, the acid solution is not strong enough. In damp weather the acid will be required to be stronger than in cold weather. The requisite strength will soon be found from experience.

Formerly, when the system was first started in German East Africa, the rubber was rolled off the tree into round balls. It followed, of course that particles of bark and dirt became mixed with the rubber, and the prodtct was consequently of poor quality. Latterly, however, this method has been improved upon, and instead of the rubber being rolled into a ball, it is now rolled off from the tree on to a small wooden roller in such a way as to form a sheet when cut from the roller lengthways. The latter method is a great advance on the method of collecting in the form of balls, as the tapper can from time to time dip the roller into a pail of water and wash off particles of bark and dirt, and subsequently put the sheet through a water.

The tapper should be provided with a rough scrubbing brush, acid and a small hand whitewash brush, for applying the acid, a wooden roller, about 6 inches long by 2½ inches in diameter, and a pail or calabash of clean water. In addition to the tapper it is advisable to have a second boy to follow him to collect the rubber, for if too many trees are tapped at a time the rubber from the first trees will not be so easy to roll off. When rolling the ribbons off they should be distributed over the roller as evenly as possible. It is desirable that the sheets should not be too thick, so the rubber should be removed

at intervals according to the desired thickness. The size of the sheets would vary, of course, according to the size of the roller used. It is desirable that the sheets should be of uniform thickness and size, so the rollers should be all the same size. The rubber should not be exposed to light more than is possible, so whenever the roller is not in use it should be kept in a pail of water, and the sheets that have been collected should also be kept in water and brought in from the plantation twice a day, after the morning and evening tapping.

It is stated that further experimentation is necessary before a definite opinion as to the merits of this method can be expressed.

TWENTY-TWO YEARS' COFFEE, TEA, AND RUBBER PLANTING.

IN CEYLON AND SOUTHERN INDIA.

AN INTERVIEW WITH MR. JAMES A. R. CLARK.

It is probable that no one has had a wider and fuller experience of Mid-East planting than has fallen to the lot of Mr J A R Clark, the well-known Travancore planter. The twenty-two years of his active service in the East, first as assistant on a Ceylon plantation and subsequently as a planter in Southern India cover precisely the most momentous period in the history of the Plantations. Mr Clark saw the vast coffee planting industry at the height of its success, saw it devastated by the leaf-disease that came suddenly and without warning and laid the coffee lands waste. Upon the ruins of this great industry he assisted in the building up of a greater industry still, that of tea, and he was among the first in Southern India to plant rubber. He is, in fact, one of that indomitable band of British planters who proved, once and for all, that so long as there is a plant of economic value to be planted, the Mid-East will never fail to make good.

"I arrived in Ceylon," said Mr Clark, in answer to our first question, "on April 1st, 1866, and took up my first position as assistant on the Niagara Estate on July 5th in the same year. The plantation was, of course, coffee."

"You did not remain in Ceylon long?"

"No. In 1869 I left for Travancore, where I became manager to my uncle, and, later, set up as a planter on my own."

"Again the plantation was coffee?"

"Yes. As of course you know, in the 'seventies came the disease which practically ruined the coffee industry. But, as a matter of fact, its results were not so severely felt in Travancore as in Ceylon, and I am inclined to think that the use of shade trees had something to do with the coffee plants' comparative immunity in Southern India. Indeed, on my old estate, there are still old coffee plants which survived the visitation of the pest, and are still flourishing."

"In the case of tea, shade trees are out of the question?"

"Quite. The present decrease in output, the large decrease which is not to be ascribed to the recent drought, is due entirely to the growth of the inter-planted rubber killing off the tea. This shortage is, of course, likely to bring about a steady increase in the planted area of tea, both in Ceylon and Southern India."

"Tell me how you prepare a tea-garden."

"We clear and fell the jungle, and then burn off. In Southern India the Government forbids the felling of valuable timber; such trees are left standing, and, after the burn, the planter settles with the Government whether they shall remove the timber or whether it shall be used on the estate."

"You do not clear away the burnt logs, or remove the stumps?"

"No; they do no harm to tea, and, not doing harm, they probably enrich the soil as they rot."

"You clean weed?"

"Yes; but we sow dadaps, a legume which shades the ground, preserving moisture, prevents waste, and keeps down the weeds."

"Do you leave a belt of forest?"

"In India, yes; as a wind-screen. In Ceylon, on the old coffee lands, the forest has, of course, been cleared away, and there is no natural wind-screen to be left, nor does the Ceylon planter prepare one." [Windbelts are very common on Ceylon Tea Estates now.—A. M. & J. F.]

"When the subject of clean weeding is discussed in connection with rubber, some people are apt to become humorous at the expense of Ceylon clean-weeding."

"Well, I must say, in the old days it was rather vigorous. Indeed, in many cases, not only the weeds but the whole of the top-soil was hoed into the rivers. Now, however, the weeding, though severe, is done without injury to the soil."

"Does the tea nursery differ from the plantation?"

"No, it is simply a part of it set aside for propagating young plants. Tea-seed, however, differs greatly in its germinating power, a good proportion is lost. Ants are very troublesome in this connection."

"What was the origin of the seeds?"

"They came from Assam, where the tea-plant is indigenous. I have found indigenous tea in Travancore, but it was of poor quality."

"What is the best soil for tea?"

"A rich loam. The elevation should be high, and the climate should be hot, and two showers a week is the ideal rainfall. Long droughts are bad for tea, as is a damp, ill-drained soil. Tea will grow at a low elevation, but it is of poor quality."

"What about manure?"

"We manure whenever necessary. Indeed, as an illustration of the value of a particularly rich soil, I may quote the case of a disused bandypetta planted up by the Mazawattee Company. A bandypetta is the enclosure where, on the old coffee estates, the laden carts and their teams were stationed for unloading. In the course of years such a place becomes richly manured, and in one instance yielded no less than a thousand lb. of tea per acre."

"Are there any special varieties of the tea plant?"

"Well, there is the indigenous plant and the hybrid jât. The quality of the finished product depends upon the growth of the plant, the climate, the condition of weather during picking, and so on; and then upon the age and size of leaf. If you take a branch, the choicest

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tea is that made from the bud at the end, the next quality comes from the leaf nearest the end, and so on, the coarsest being that from the leaves gathered furthest from the tip. All the leaves undergo precisely the same treatment, they are then graded according to size of leaf, which coincides, of course, with its former position on the growing plant; and, speaking of varieties, reminds me of some other popular misconceptions. For instance, many people suppose that the small round berry coffee (peaberry) comes from a plant that differs from that producing the ordinary berry, whereas it is merely a varying method of seed growth of the same plant. But the most curious error I have ever met was that made by a man who certainly should have known that mace is a growth round the nutmeg. This man urgently requested me to plant more mace and less nutmeg."

"Have you found that methods of preparing have varied greatly as time has gone on?"

"No; except, of course, that the advent of machinery has greatly simplified the work of the factory, and much that was once done by hand is now done more quickly and more efficiently by machinery."

"What are the principal markets for Indian and Ceylon tea?"

"Great Britain takes the bulk. Australia is a large consumer. Practically the trade is Imperial."

"Russia does not take much?"

"Little, if any. Russia takes the bulk of the best China tea." [Russia last year took nearly 20,000,000 lbs. from Ceylon.—A. M. & J. F.]

"Prices have varied greatly during your experience of the industry?"

"Yes, the average price was once two shillings and, gradually, dropped to sixpence; the price has now risen again to ninepence, and, until further areas are planted up, is likely to go higher."

"The coffee planting is becoming successful again?"

"Yes. The new robusta, though of a coarser flavour than the Arabian, is so prolific, giving 14 cwt. against 8 cwt. of Arabian, that it is naturally popular. But the older variety is also doing well in the East. In a rubber plantaion in which I am interested we shall plant coffee as a catch crop."

"You did not have much to do with rubber planting?"

"No. I left the East before the value of rubber was fully recognised. But I was unwittingly one of the earliest rubber planters, and my trees, which were planted for shade, are now giving excellent yields of rubber."

In conclusion, Mr. Clark expressed his entire confidence in the future of the great Mid-East rubber and tea industry, in which he expects to see big developments in the near future. He has also faith in the future of Mid-East coffee, and as "experientia does it," even in the regions of prophecy, his opinions naturally carry great weight.—*Rubber World*, Oct. 5.

TEA IN 1910-11.

BROOKE BOND & COMPANY'S REPORT.

October 27, 1911.

DEAR SIR,—The increase in the consumption of tea throughout the world, which we have pointed out in our annual review of the history of the Tea-Trade for some years past, continues. At the present time, instead of planters having to sell their tea almost for anything they could get and to tax themselves in order to exploit new markets, as was the case from ten to five years ago, the demand for British-grown tea is greater than the supply and prices have been paid this year for common tea which have not been equalled for twenty years. The average price for all tea has also risen considerably. Rather more than four years ago, as we pointed out in our annual letter in 1907, consumption overtook supply. Prices thereupon rose and the planter, after a time, began to reap some slight reward for his long years of hard, almost unremunerative, toil and for his persevering efforts to find new markets for his teas. Since then production has continually increased, but consumption has increased still faster and is now distinctly in advance of supply. We say in advance of *supply*, rather than of *production*, because in all probability large quantities of tea are grown and consumed in all the producing countries, particularly in China, of which no record reaches the outside world. The proportion borne by the various countries in supplying the world's demand remains much the same as last year, all of them having increased their output except Ceylon. By far the greatest part of the tea concerning which we have reliable statistics is grown in India and Ceylon, most of the rest coming from China, Japan and Java. Small quantities are grown also in Natal, Nyasaland, Burma, the Straits Settlements, the Mauritius, Queensland, the Fiji Isles, Brazil and the Caucasus, but are almost entirely consumed locally; some also in Annam, part of which is exported to France.

INDIA.

India produced a record crop during the year 1910-11, her exports up to May 31st, 1911, to which date we have official figures, including Southern India, reaching the large amount of 258,384,800 lb, about 4,000,000 lb more than during the preceding twelve months. It seems probable that when we see returns for the twelve months ended September 30th, we shall find that the increase is even greater, and the crop of 1910-11 is as much as 15,000,000 lb ahead of that of 1909·10.

The following table gives the distribution of Exports from India during the last four years:—

	1910-11 lb.	1909-10 lb.	1908-9 lb.	1907-8 lb.
United Kingdom	174,100,700	180,083,200	168,093,[illegible]00	161,438,400
Australia	9,595,900	8,604,800	8,936,800	10,946,200
America	5,606,900	5,609,900	5,[illegible]00,500	3,744,300
Russia and China	40,347,500	30,490,500	25,443,100	27,755,600
Other Ports	10,478,800	10,849,500	12,877,800	9,837,700
Total from Nth. India	240,129,800	235,637,900	220,851,600	213,722,200
Southern India	18,255,000	16,616,000	15,243,100	15,262,400
Total from all India	258,384,800	252,253,900	236,094,700	228,984,600

Russia and China are coupled together in this table, because practically all the tea sent from India and Ceylon to China consists of dust and siftings which are manufactured, in factories belonging to Russian firms, into "Brick" tea, for consumption in Asiatic Russia. A statement appeared in a Chinese newspaper last February to the effect that the Chinese Minister of Trade intended to stop the importation of foreign tea into China. This would have been injurious to the Indian and Ceylon planters, who are in the habit of sending to Hankow every year about 15,000,000 lb of dust and siftings to the value of about £400,000, It was not, however, necessary for them to move in the matter, as the rumour was not confirmed. It is said that the factory owners protested through the Russian Ambassador against the proposed course, and even threatened to remove their factories from China. The admixture of about 10 per cent to 15 per cent of the strong liquoring dust from India and Ceylon greatly improves the "bricks" and facilitates their sale. The area under tea in India has not much increased during the year; the difficulty of obtaining coolies is so great that most planters now devote their attention rather to increasing the productive power of the existing gardens than to extending their area.

CEYLON.

Up to the end of 1910 the total export from Ceylon had fallen over ten million pounds. During the early months of this year it recovered considerably, but not sufficiently to bring the total nearly up to the record output of 1909-10, which was very little short of 192,000,000 lb. The deficit is attributed partly to the drought and partly to the greater attention given to rubber. Some experts think that with favourable climatic conditions the output of the island will remain at about the same level for some years to come, for although the increase in rubber planting tends to reduce the area under tea, better cultivation increases the yield. Also there is much high ground in Ceylon very suitable for tea, where rubber cannot be grown. About 60 per cent of Ceylon's crop goes to the United Kingdom, the rest mostly to Australia, Russia and America. There is a growing opinion in Ceylon that there is an excellent opportunity just now for establishing a good trade with the United States in natural green teas, to take the place of the coloured teas formerly imported from China and Japan. Ceylon has paid increasing attention to green tea the last few years (a new and well equipped finishing factory is now in course of erection at Colombo) with the result that during the year under consideration 1,500,000 lb. more of it were exported from Ceylon to America than in 1909-10. It is expected that a good deal more green tea will be made in the island during the current year. The great feature of the year with regard to British-grown tea, both Indian and Ceylon, is the immense increase in direct shipments to foreign countries, particularly to Russia. Many Russian merchants who formerly made their purchases in London, now buy almost entirely in Calcutta and Colombo.

NATAL.

Owing to the drought it is probable that the output of Natal tea will be about 50,000 lb. less this year than last, *viz*: 2,042,000 lb. instead of 2,092,000 lb. The demand for this tea increases steadily. If the output were doubled, the whole would probably easily be consumed in South Africa. So far, though, from there being any prospect of substantial increase in the crop, it seems as if, owing to the scarcity of labour, the planters would have a difficulty in keeping it up to its present level. Until this summer the greater part of the work has been done by indentured labour from India, but the Indian Government last June refused to allow any more coolies to go to Natal. Local labour is almost unobtainable, as tea cannot pay the high wages offered by gold and other industries. It has been suggested that men should be brought from Nyasaland, but even if that were practicable, they would cost twice as much as Indian coolies. One writer on the subject thinks that the tea and sugar industries of Natal will soon be things of the past, but that is hardly likely.

NYASALAND.

It is estimated that there are about 20,000 acres of land in Nyasaland suitable for tea growing, of which about 600 are at present under tea, while there is an increasing demand for land round about the existing gardens. Some of the land is leased by Government at 6d an acre, some sold outright at 10s. Last year's output was about 56,000 lb. The aroma and flavour of the tea are said to be very good, superior to lowcountry Ceylon. Tea promises to be very profitable in Nyasaland, as labour is cheap, the natives like the work, and the tea area is within twenty miles of the Shire Highlands Railway.

CHINA.

Exports from China increased on the whole during the year. Shipments to the United Kingdom and to Russia rose, but the United States took 23 per cent less green and 71 per cent less black tea than during the preceding year. The trade with the United States has been affected by the new regulations, which came into force May 31st, 1911, forbidding the importation of artificially faced or coloured teas, of which until this year about 15,000,000 lb. have been annually shipped to the States from Shanghai. In spite of the publication of this law, about 40,000 chests of coloured tea were manufactured and sent to Shanghai for exportation. Some of it was actually shipped to the States, but was rejected as impure. It has been suggested that possibly the manufacturers did not take the prohibition seriously, or thought that the authorities would be induced to relent.

JAVA.

The production of tea in Java increases steadily, though not rapidly, but the total output is still so small compared with that of India and Ceylon, that it does not make much difference so far as satisfying the world's demand is concerned. In Java, as in most of the other tea-producing countries, production is hampered by the labour difficulty, the supply of native labour not being sufficient for both rubber and tea, and the Government putting difficulties in the way of importing Chinese labour. During the year exports to the United Kingdom and Australia increased considerably, but less was sent to the Netherlands. The United Kingdom and the British Colonies take about 40 per cent of the whole amount exported.

JAPAN.

Exports from Japan increased during the year, but not to any great extent. The quality of the leaf is not as good as it has been. Machinery is now generally used and has not been brought to sufficient perfection to turn out as good tea as was formerly made by hand. When the United States passed the law forbidding the importation of coloured tea, a regulation was issued by the Japanese Government prohibiting the manufacture or handling of such tea in Japan. As, however, Canada gave some large orders for tea of this kind, the Government decided that the regulation should not come into force until September.

FORMOSA.

Formosa produces about 24,000,000lb. a year. The tea is different from all other teas, being partly fermented and therefore something between a black and a green tea. It is principally used for flavouring. The best kinds are highly valued. The first crop of this year is reported as being of exceptionally good quality.

CAUCASUS.

The amount of tea grown in the Caucasus does not affect the world's supply, though the quantity is steadily increasing. The tea can be delivered in St. Petersburg at a cost of about 2s. a pound.

BRAZIL.

Experiments in tea growing have for some time past been made in Brazil. A sample lately received in London was of excellent quality, resembling good Ceylon. Possibly at some future time the shortage in the world's tea supply caused by the inter-planting of rubber in the old tea-producing countries of Asia, may be supplied from the rubber districts of Brazil.

BURMA.

The tea grown in Burma is almost entirely made into *letpet* (pickled tea) and eaten as a condiment. It therefore does not affect the world's supply of tea for drinking.

CONSUMPTION OF TEA.

Turning from the consideration of the *production* of tea throughout the world to that of *consumption*, we find that it also, as we said above, has considerably increased. In the United Kingdom consumption per head of population has risen to 6·39 lb., higher than in any other part of the world except Australasia. The following table shows the amount contributed by the various producing countries in supplying the tea consumed in Great Britain and Ireland during the last two years, and the proportion these amounts bear to one another. The figures are those given by the President of the Board of Trade in the House of Commons on August 8th last.

	Year ended June 30th. 1911. lb.	percentage	Year ended June 30th, 1910. lb.	percentage
British East Indies (except Ceylon)	164,456,000	57·00	149,885,000	54·68
Ceylon ..	91,098,000	31 58	95,083,000	34·69
China ..	12,192,000	4·22	8,834,000	3·23
Java and other countries ..	20,757,000	7·20	20,303,000	7·40
Total ...	288,503,000	100·00	274,105,000	100·00

Russia continues to be India's best customer outside the United Kingdom. Her whole population, over 120,000.000, drink tea and drink a good deal of it. They are gradually giving up China tea and taking more from India and Ceylon. There has been a succession of very good harvests, causing consumption by the peasantry to increase. It is possible that their buying power may diminish a little this year, as the harvests in several districts are not good, but this is not likely to make much difference in the total amount imported. Official statistics show an increase of 7,110.000 lb, or 29·6 per cent, imported from India, during the year ended March 31st, 1911. The increase from Ceylon is estimated, to July 13th, at 1,400,000 lb. Calcutta has now a direct steamer service to Russia.

During the year under consideration, *Australasia* took about 750,000 lb more from India, rather less than usual from Ceylon, and a good deal more from Java, than during the preceding year.

In the *United States* there is no doubt that tea is gradually, though slowly, coming into favour. This has probably been partly caused, lately, by the high prices of coffee. During the year under consideration the States imported over 20,000,000 lb of British-grown tea, in the proportion of about 12,000,000 from Ceylon and over 8,000,000 from India.

As we remarked when speaking about China tea, the prohibition of the importation of coloured tea into the States will probably have the effect of increasing the consumption of British-grown tea. The new regulation will dobtless raise the standard of the tea imported. Until this law came into force a certain amount of " scum," *i.e.*, floating colouring matter, was allowed, but will be permitted no longer. This will be to the advantage of Indian and Ceylon green teas, which are absolutely free from colouring matter.

On the continent of *Europe* tea-drinking is increasing generally. The increase in the consumption of Indian tea is particularly marked in *Belgium*, doubtless owing to the good work done at the Brussels Exhibition, which will no doubt be carried on at the three Exhibitions shortly to take place, at Dresden, Turin and Charleroi.

Complaints are still made that it is difficult to get good tea in *France* (though a French paper said a little while ago that Paris had gone tea mad) except at the very best hotels and cafes, where very high prices are charged. The fault is doubtless a good deal in the making, but is also due to the quality of the tea itself. The greater part of the tea consumed in France comes from Annam and is of very poor quality, but as it comes in duty-free, while other tea has to pay a tax of 11¾d a pound, it is naturally cheaper in proportion. Also, French merchants frequently buy their tea by the appearance only without tasting it, so that even if they buy it in England they often do not get tea likely to give what an Englishman calls a "good cup."

It is extremely difficult, practically impossible, to get reliable statistics as to the consumption of tea in *India* itself, but there is no doubt that it is increasing. It is estimated at from 7,000,000 lb to 12,000,000 lb a year, but these figures are more or less conjectural. The natives are certainly taking more, and many native traders are interested in the trade.

We think that the above details prove that the position of the tea producer is happier than it has been for many years past, though his life is far from being an idle or even an easy one, nor is it by any means free from cares and anxieties. The position of the distributor is not at the present moment quite as happy. He has on the one hand to pay high prices for his teas and on the other to satisfy consumers accustomed for years to pay very low prices for really good tea. He suffered this spring, as usual, from the dislocation of trade which takes place yearly before the declaration of the Budget, owing to the anticipation of a change in the duty. This year, also, the strike greatly interfered with his trade, tea being affected by the stoppage of work at the Docks as much as any commodity and more than many.

Nevertheless, in spite of all these drawbacks, the trade continues to be in a fairly flourishing condition, both with regard to production and to distribution, tea being considered by most people, in spite of all that has been said to the contrary a necessity of life.—yours faithfully, BROOKE,, BOND & CO., LTD.

HOW RUBBER PROGRESSES.

A SCHOOL OF TECHNOLOGY IN LONDON.

A school for the practical training of young men in the technology of rubber is being formed at the Northern Polytechnic Institute, Holloway. On Thursday next a course of instruction on "Rubber, its Chemistry and its Analysis" will be commenced by Mr. F. Kaye.—*M. Post*, Oct. 21.

The extensive industries of rubber production and of rubber goods manufacture, of many millions value per year, have not as yet, like other great industries in England, had special attention from educational authorities. Now, however, a school devoted to rubber technology is to be established at the Northern Polytechnic Institute, Holloway, N. Tomorrow a practical course on Rubber—its chemistry and its analysis—will commence at that institution to be organised by Mr. Frederick Kaye, A. R. C Sc., who has done much work in rubber investigations in several foreign countries as well as in England. It is to be hoped that this venture will be rewarded by the development of a world-known school devoted to rubber chemistry and industrial rubber problems.—*F. Times*, Oct. 25.

AGRICULTURE IN JAPAN.

I.

The Agricultural Bureau of the Department of Agriculture and Commerce has issued an interesting and instructive volume* dealing with the agriculture of this little state so renowned for the industry of its people. As the preface by the Director announces, the work has been compiled for the information of the outsider rather than for the edification of the indigenous population.

The book, consisting of 132 pages, opens with an introduction dealing with the Geography, Topography and Climate of Japan; part I. treats of the conditions of agriculture; part II. with agricultural products; part III. with agricultural administration; and part IV. is specially devoted to Formosa and Karafuto.

The chief characteristics of Japanese agriculture are (1) that the first place is given to the cultivation of rice, that cattle are used for all agricultural operations, and that with the cultivation of crops is combined the subsidiary industry of sericulture; (2) that cultivation is conducted on a small scale and is intensive in character (70 per cent of the farmers cultivating an area of not more than 2 acres each, 3 per cent cultivating not more than 7½ acres each)—a condition due to the small size of the country and the denseness of its population, necessitating high cultivation and the raising of two crops in a year.

In Ceylon the need for emulating the example of the Japanese, or even of the South Indian, does not exist, and hence the complacency of the husbandman, who, with all the frailties of an imperfectly educated human being, does not labour more than is absolutely necessary for his sustenance, and often fails in this. In manuring he does little or nothing worthy of the name, while in this respect it is computed that the Japanese annually use 200,000,000 yen (equivalent to about £2,000,000) largely consisting of soya-bean cake—the residue of soya-beans after the expression of the oil.

From the tables furnished it appears that not only is the area under various products increasing, but the rate of increase of the output per unit of land is very high. During the past 20 years the output of rice has increased by 37 per cent., barley by about 40 per cent., soya-bean by 13 per cent., sweet potatoes by 64 per cent., buckwheat by 10 per cent., while potatoes have increased 4½ times, and the output of cocoons 3 times. This is a notable record, and proves the value of a well-organised Agricultural Department of which Japan is the happy possessor.

The cultivation of rice, which is described as "the very life of Agriculture in Japan" must be referred to in a separate article. When compared with the Japanese cultivator, our Ceylon goiya may be said to be only playing at rice growing. There is also much for us to learn as regards agricultural organisation, co-operative societies, &c., from Japan.

The work under review is well printed and illustrated, but is marred by the poor quality of its English. Still as a record, and an instructive manual, the book is a distinctly valuable contribution to current agricultural literature.

II.

One of the most interesting subjects treated of in this work is that of rice growing.

There, as here, the bulk of the rice crop is raised on fields under irrigation, but with this difference—that in Japan, as a rule, two crops are raised each year on the same field, of which rice is one the other being more or less a dry crop.

The annual output of rice is valued at about £81,000,000, and the protection and encouragement of its production, form the chief problem of agricultural administration, the Government employing every possible means for improving the cultivation.

Rice is distinguished as nonglutinous and glutinous, but the output of the latter does not exceed 1-10th of the former. Glutinous rice is boiled and eaten, while the nonglutinous variety is converted into flour for making cake, and also employed in the manufacture of the spirituous liquor called "sakē."

In improving the quality of rice, as well as the method of preparing and packing the grain, so as to give it the best value in the market, a system of rice inspection has been established with a view to producing a uniform quality. There are also institutions known as "common rice depôts" for the storage of rice. The prepared grain may be consigned by a cultivator to these warehouses where a rigorous inspection is made with a view to grading the grain so that all of one quality may be bulked together. Receipts are issued to the consignors, and these may be sold or otherwise disposed of by the holders. This arrangement has been instrumental not only in improving the quality of rice, but also in greatly facilitating transactions. Rice is packed for sale in bags made of straw.

The details of cultivation do not vary much from those in vogue in Ceylon as regards their sequence, but in other respects there is a material difference. The seed is never broadcasted, but first planted in a nursery and afterwards transferred to the field, where the plants receive proper fertilising, weeding, &c., so that high yields may be secured.

Upland rice (or what is known in Ceylon as Hill paddy) is cultivated in high lands and is coming to take the place of the millets usually grown in such situations. The proportion of upland rice does not, however, exceed 3 per cent. of the total rice output, though there is a tendency for this proportion to increase.

Japanese rice finds its way chiefly to Hawaii, to the United States and to Canada, as well as to Russia in Asia, China and even England. There is some importation of rice, but Indian grain is looked upon as inferior in quality and is chiefly consumed by the poorer classes.

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* Outlines of Agriculture in Japan (Department of Agriculture and Commerce, Tokyo.)

INTENSIVE CULTIVATION IN JAPAN.

Negombo, Nov. 4th.

SIR,—I have read two or three letters in your paper *re* intensive cultivation, but in an article headed "Agriculture in Japan" and in para 3 line 7 it speaks of intensive cultivation. I don't think that intensive cultivation is there used to mean as cultivation under glass, so I shall thank you or your numerous readers to enlighten me what is meant by intensive cultivation there.

Can you please inform me where I can get a copy of the Report of Agricultural Department of Japan?—Yours truly

S.W.A.N.

[The term intensive cultivation as applied to agriculture (and as opposed to extensive cultivation) is the raising of crops on comparatively limited areas of land which is given the most liberal treatment, as regards tillage and manuring, so that the soil is made to return maximum yields.

The work on The Agriculture of Japan was issued by the Bureau Agriculture, Tokyo.]

INTENSIVE HORTICULTURE.

November 1st.

SIR,—With reference to the letter by "Economical Householder" in your last issue the term "intensive horticulture," or "French Gardening," as it is also called, can hardly be applied in the tropics. It was a good deal talked of in England some two or three years ago, chiefly through the efforts of the *Daily Mail.* Its interpretation refers not so much to magnified crops from a given area or to their improved quality, as to the securing of crops of both fruit and vegetables as early as possible in their respective seasons, or even out of their normal season. Thus strawberries produced at Christmas may fetch from 5s to 8s per lb. or more, and new potatoes or peas in March will command almost any price. In France, cloches (large invented earthenware vases) are extensively employed for forcing vegetables, for which there is always a large demand. While this, however, is a profitable business in France, it is not so in England, except on a limited scale. In the former country the consumption of vegetables for salads, &c., is enormously greater in proportion to the population than in the British isles; labour also is cheaper, and transport less costly than in England.

Obviously, therefore, the conditions for "intensive horticulture" do not at present exist in Ceylon. It is possible, however, that one *might* secure certain crops here out of their normal season by means of an extensive refrigerator; but while the average native procures his supply of herbs or salad material from the nearest jungle or marshes, without money or price, it is doubtful whether such a venture would pay.—Yours faithfully,

SYMPATHISER.

PATENT FLEXIBLE HARROW.

Wauwe, Beliatte, Oct. 27.

SIR,—I have used the patent flexible harrow of Messrs. Hunter & Co., Colombo, for preparing the soil of ploughed land for sowing paddy, and I find that it answers the purpose very well. Three acres of ploughed land can be prepared for sowing in a day by a pair of buffaloes, work being generally done by eight pairs. The field, further, is thoroughly levelled by the process and requires no weeding. This implement will prove beneficial to rice cultivators in saving time and expense with good results.—Yours faithfully,

J. B. RATNAYAKE.

Beliatte, Nov. 8th.

SIR,—*Re* my article dated 27th ultimo on the above named implement, I beg to state that I have received several letters asking for further particulars of it, and I shall thank you to give insertion to this in an early issue of your widely read paper.

I may add that this implement was recommended to me by the Secretary of the Agricultural Society on my enquiring of him whether he knew of any implement that would level and clear off the grass on the surface of ploughed land. He would, I dare say, be able to give better particulars on the subject than I.

The Harrow consists of twenty one triangular links of round wrought steel with teeth bent downward horizontally and adjusted in a triangular form in sections. The Harrow could be adjusted by the removal of a whole row of links or two so as to reduce the size to suit the cattle being used.

In its full size it is rather heavy for a pair of buffaloes. By the removal of the last row of links, I worked it with a pair of buffaloes, and three acres of land were harrowed in a day. Reducing the size yet more I have even used a pair of country bulls in it. The grass is rooted out, and the ground is thoroughly levelled which is not otherwise the case with the usual local processes.

It besides answers very well for the second ploughing.

Two men should be employed in its working—one for driving the pair of animals, and one for removing the accumulations by raising it side-wise and also for guiding it over ridges. By the employing of a third man this last could be more effectually and easily done. A support should also be used to press it down at times when the rows of links protrude upwards.

The results are admirable and very satisfactory, for I find that the paddy plants in a harrowed area look very verdant and fresh. The soil is evenly levelled and broken up and the removal of weeds greatly facilitated by this Harrow.

This implement could be used on soft as well as on hard land.—I am, Yours faithfully,

J. B. RATNAYAKE.

WORLD'S VISIBLE SUPPLY OF RUBBER.

SATISFACTORY POSITION.

Mr H V E Longworthy, of 9, Mincing-lane, E.C., reports, under date of October 5th as follows :—The world's visible supply of Para and Caucho on October 1st was 6,328 tons, against 4,721 tons on the same date last year ; thus the world's visible supply is now only 1,607 tons in excess of that of last year, whereas on May 1st the world's visible supply was showing an increase over the previous year on the same date of 7,569 tons.

Another feature of interest are the deliveries for the month of September of Para and Caucho at Liverpool. The imports are given as 866 tons, whereas the deliveries are 1,953 tons. The figures for the whole of England for the month of September show that we imported 2,901 tons whereas the deliveries were 3,888 tons, and the stock on 1st instant was 3,920 tons, against 4,660 tons last year.

AMERICAN MARKET ADVICES

do not indicate any recovery in the demand for the raw commodity, which is still very slack, although it is thought possible that prices may be marked higher. The manufacturers of motor vans and lorries are combining in several instances, so that savings in expenses may improve the position of the respective companies. The tyre trade is reported as being still very good, with all factories running at full time. The usual monthly statistics issued by the Government Bureau of Commerce at Washington show that the

INCREASE IN THE EXPORTATION OF MOTORS OF AMERICAN MANUFACTURE

has been almost as rapid as the growth in their use in the United States. The total value of automobiles and parts thereof exported in 1901, only a decade ago, was less than $1,000,000 ; in 1902 it passed the $1,000,000 line; in 1903 it was more than $1,500,000 ; in 1905 $2,500,000; in 1906 $4,500,000; in 1907 $5,750,000 ; in 1909 $7,750,000 ; and in 1910 $13,000,000. For the seven months of the year for which export statistics are available, over $9,000,000 worth of automobiles were exported, $2,000,000 worth of parts thereof, other than tyres, and $1,500,000 worth of tyres, making the aggregate for the seven months $12,500,000. Should the exports continue at the same rate during the five remaining months of the year, the total would cross the $20,000,000 line.—*F. Times*, Oct. 3.

In view of the more irregular market ruling for the standard commodity, we give the following figures, showing the statistical position at October 1st, for which we are indebted to Messrs Lewis and Peat:—

	Tons.
Increase in receipts during September, 1911, against September, 1910 ..	615
Decrease in receipts—July-September, 1911, Para sorts against last year ..	565
Increase in deliveries—September, 1911, against September, 1910 ..	2,070
Increase in visible supply Para kinds, against October 1st last year ..	2,487
Decrease in stock, London and Liverpool, September 30th, 1911, against stock 30th September, 1910, all sorts ..	293

—Ibid., Oct. 5.

CEYLON AND MALAYA RUBBER EXHIBITS.

SOME EXPERT CRITICISM.

The following criticisms on the Ceylon and Malayan Exhibits at the Rubber Exhibition in London, have been written by Messrs Lewis and Peat.

"We feel," say Messrs. Lewis and Peat, of Mincing Lane, "we must begin this little criticism by congratulating planters on the excellent quality and condition of practically all the samples sent in for exhibition. The improvement in the preparation against the last exhibition is the most striking feature. The bulk of the samples of Hevea shown were in blanket crepe form, and nearly all were well nigh perfect. We are still of the opinion as expressed in our Details for Planters, published in January, that the two best forms of preparation most suitable for the market and the most readily saleable are blanket crepe and smoked sheet, and at this Exhibition practically all the Estates, both in Ceylon and Malaya, sent most excellent exhibits prepared in either or both of these two ways. Colour is not of such importance as formerly in 1st latex rubber, but oil stains and any admixture of scrap, cupwashings or lower grades is very strongly objected to. Also scrap and bark or shavings rubber must be kept separate and all made into thick gristly crepe.

"We cannot say much yet about smoked crepe, as comparatively little has been sent so far, but this grade is shortly to be admissible on 1st latex contracts and is fetching very similar prices as unsmoked crepe or sheets at auction. Up to now the parcels sent have been inclined to be sticky, especially when crepe is thin, and care must be taken to make the smoked, when it is finished, quite as thick as the unsmoked.

"Owing to the much larger quantity of smoked sheet coming to the market the premium ruling until quite recently has practically disappeared, but the grade is as popular as ever, and as readily saleable as any other make offered. The use of heavily ribbed rollers has done a great deal to improve the condition and we see very little mouldy now and practically no stuck and heated smoked sheets.

"Scrap in good gristly blanket form is in great demand, and fetches much better prices than in the loose form."

£1,000,000 RUBBER AT AUCTIONS.

IN LONDON IN EIGHT WEEKS.

At the public auction sales of plantation rubber, one broker succeeded in clearing off 200 lots in fifty minutes, which is probably a record. The Vallambrosa Company has sold at this sale about eight tons, of the estimated total value of £4,250. Since the 1st September to date, according to a computation made in the 'Lane,' 1,600 tons of plantation rubber have been sold in that centre, amounting in value to about £1,000,000, which will revert to the various Eastern plantation companies. It is also stated that manufacturers generally are now taking this description of the commodity, and as will be seen above are paying higher for it than for Brazilian Para.—*F. Times*, Oct. 19.

THE RUBBER MARKET.

MR. JOSEPH FRASER'S VIEWS.

Mr. Joseph Fraser, the well-known V. A. and rubber expert, seen by our representative on his arrival from home said that the Rubber Exhibition was a very good one, and, as far as he could tell, decidedly better than the one before, although he had not seen that one. It should have a good effect on the industry as far as Ceylon was concerned.

QUALITY OF CEYLON RUBBER.

Asked as to the complaints about the quality of Ceylon rubber, Mr. Fraser said there were certain complaints with regard to Ceylon rubber not being sufficiently dry, and he was of opinion that more attention should be paid to drying in Ceylon. Complaints as to quality were often caused by the fact that many samples of small estates appeared in the market. The manufacturer found it difficult when there was such a variety of small lots. It was not that the rubber was bad, but that there was such a variety. There were few, if any, complaints against the large estates, so far as he could make out. Uniformity would come when the estates were large enough. The manufacturers he had met told him that they were prepared to take as much of the class of rubber that came from the large estates as they could get. Ceylon rubber was certainly not compared at a disadvantage with that from the Straits.

THE HOME MARKET.

Speaking of the rubber market at home, Mr. Fraser said it was quite satisfactory, the price being at from 4s 6d to 4s 10d a pound. He thought there would be a gradual fall in price, not a rapid one. It would be some considerable time before the price went under 3s a pound. Under any particular stress it might go under, but the fall would be only temporary. He did not consider there was any danger of overproduction for some considerable time, because as the price fell the product would be more used. For that reason, last year's high prices did more harm than good, for in some cases manufacturers had to close down for certain classes of goods.

THE LABOUR PROBLEM.

Referring to labour, Mr Fraser said he fully agreed with the attitude of the *Observer* that coolies should be landed free of debt. Advances, in perhaps the majority of cases, were quite illegitimate, and should never have been allowed to reach their present figure. Amounts given as bonuses to the kangani should have been wiped off at the time, and nothing but what the cooly actually owed to the kangani himself should be allowed to be put as a debt against his name.

CULTURAL DIRECTIONS FOR PAPAYA.

BY P. J. WESTER, HORTICULTURIST.

The Philippines Bureau of Agriculture has issued the following directions for growing Pappaws which should prove of interest and be useful to Ceylon residents. There are not nearly enough papaws grown in Ceylon.

SEED BED.—The seed bed should be prepared by thoroughly pulverizing the soil by spading or hoeing the ground well, and the clearing away of all weeds and trash. Sow the seed thinly, about 1 to 2 centimeters apart, and cover the seed not more than 1 centimeter with soil, then water the bed thoroughly. In the dry season it is well to make the seed bed where it is shaded from the hot midday rays of the sun, under a tree; or, it may be shaded by the erection of a small bamboo frame on the top of which are placed grass or palm leaves. If the seed is planted during the rainy season a shed of palm leaves should always be put up over the seed bed to protect the seed from being washed out and the plants from being beaten down by the heavy rains.

TRANSPLANTING.—When the plants have attained a height of about 7 to 10 centimeters, they are ready to be transplanted to the place where they are intended to grow.

Unless the transplanting has been preceded by a good rain, the plants should be thoroughly watered before they are removed from the seed bed. In order to reduce the evaporation of water from the plants until they are well established in their new quarters, about three-fourths of the leafblades should be trimmed off.

In transplanting, take up the plants with so large a ball of earth that as few roots are cut or disturbed as possible. Do not set out the young plant deeper in the new place than it grew in the nursery; firm the soil well around the roots, making a slight depression around the plant; water thoroughly.

In order to protect the tender plant from the sun until it is established, it is well to place around it a few leafy twigs at the time of planting. It is well to set out three plants to each and as the plants grow up and fruit, to dig out the males or the two poorest fruiting plants.

If the plants can not be set out in the field at the time indicated, transplant them from the seed bed to a nursery, setting out the plants about 20 to 30 centimeters apart in rows a meter apart, or more, to suit the convenience of the planter. While the best plan is to set out the plants in the field before they are more than 30 centimeters tall, the plants may be transplanted to the field from the nursery with safety after they are more than 1.5 meters high, *provided that all except young and tender leafblades are removed, leaving the entire petiole, or leafstalk, attached to the plant*; if the petiole be cut close to the main stem, decay rapidly enters it. If the entire petiole is left it withers and drops and a good leaf scar has formed before the fungi have had time to work their way from the petiole into the stem of the plant.

TREATMENT OF OLD PLANTS.—When a plant has grown so tall that it is difficult to gather the fruit, which also at this time grows small, cut off the trunk about 75 centimeters above the

ground. A number of buds will then sprout, from the stump, and will form several trunks that will bear fruit like the mother plant in a short time. These sprouts, except two or three should be cut off, for if all are permitted to grow the fruit produced will be small.

Seed Selection.—Seed should be saved from the best fruits only. By this is meant not so much a *large* fruit as one that is sweet and well flavored, with a small seed cavity and few seeds; oblong fruit should be preferred, to roundish ones in saving seed, as they grow on plants having both stamens and pistils in the same flower and these being, very largely, self-pollinated, the seeds produced from such flowers are more likely to reproduce their kind than the seed from roundish, melonshaped fruits, which mostly grow on female plants.

All male plants should be destroyed wherever they appear, as not only are they unproductive but by their pollen being carried to the fruiting plants they tend to produce degenerate plants when these are grown from the seed produced on plants growing in the vicinity of the male plants.

There is no need to fear that the other plants will not fruit if the male papayas are destroyed, for the reason that there are always plants about having *perfect* flowers and which provide sufficient pollen for the fructification of the female plants. This applies particularly to the Hawaiian papaya.

General Remarks.—The papaya is very impatient of water standing around the roots and should be planted only on well-drained land; being easily injured by strong winds, it should be planted in sheltered situations.

Keep the land clean of weeds and the plants well mulched.

MR. W. WICHERLEY ON THE VALUATION OF COCONUT ESTATES.

Sir,—In view of the present undoubted activity both in trade and company promoting circles with respect to the copra industry, it may not be out of the place to submit a few salient facts regarding output and values of average coconut estates such as would appeal to the British investor. Primarily it must be borne in mind that the majority of these properties are native owned, and for the most part grossly neglected as regards cultivation, and wastefully managed into the bargain.

A full-bearing tree will yield 40 to 60 nuts for copra per annum in six pickings, and 4,000 to 5,000 nuts are required to make one ton of copra. Malabar and Ceylon copra fetches £3 to £4 per ton more than the kiln-dried copra of Malaya and the Pacific Islands. One hundredweight of copra will give 68 lb. of oil and 44 lb. of "poonac" or cattle cake. The husks taken from the nut intended for copra are utilised for making fibre (coir) and 1,000 husks will produce 1 cwt. of bristle fibre and 5 cwt. of mattress. As regards the other utilities to which the tree lends itself, such as the making of "toddy," &c., these have little concern for the European investor.

"Poonac," which, as already stated, is the residue "cake" after the oil has been expressed from the copra, is a valuable cattle food, much superior either to linseed or cotton cake, as the following analysis will show:—

Food.	Carbo-hydrates.	Albu-minoids.	Fats.	Water
Coconut cake	46·60	18·11	11.21	9·7
Linseed	27·10	24·17	8·5	12·17
Cotton cake	14·3	17·1	5·21	11·2

Valuations of coconut estates based on the per capita value of each tree are fallacious and utterly worthless from an investor's point of view, inasmuch as no two trees will yield alike, neither are they by themselves insurable against disease, pests, storms and other risks always associated with tropical agriculture. One of the recognised systems (and perhaps the best) is to take a qualified expert's report on the property as a whole, and then to dissect the certified "counts" of nuts for each of the six picking periods over the previous four years, carefully noting the picking of the fifth period, as this should always give the largest proportion (20 per cent. to 25 per cent.) of the total yield.

Where these records are not available—which is very often the case with native-owned properties —the safest plan is to take an average of 20 to 45 per tree (according to their condition and age) and divide the total into thousands, multiply that amount by three, and in this manner we get approximately the net annual income from the estate.

Thus, suppose a property contains 500 acres of fully-bearing palms, planted 60 to the acre, the census (supposing there are no vacancies) will give 500 by 60 equals 30,000 trees. At 40 nuts per tree the yield will be 30,000 by 40 equals 1,200,000. Multiply 1,200 by 3 we get net income £3,600, which at twelve years' purchase gives a value of £45,200. Deductions are made (1) in the case of leaseholds, (2) where buildings, plant, &c., are in a state of disrepair or do not exist, and (3) where there are evidences of neglect in present cultivation. The balance will then represent the full value of a native-owned coconut estate.—I am, &c.,

W. Wicherley.

22, Limes-grove, Lewisham, S.E.
—*F. Times*, Oct. 21.

BANANA WINE

has, according to the *Siècle*, been successfully manufactured at Saigon, in Cochin China, by two Frenchmen, M. M. Guerin and d'Hèerille. The product is obtained by the fermentation of the banana juice with yeast made from the fruit. The liquor, besides being much cheaper than ordinary spirit, is said to have a delicious perfume.—*M. Mail*, Nov. 3.

THE QUEENSLAND NUT.

Considerable interest attaches to the news that Americans are planting the "Qeensland nut" in great quantity in California. The American Government recently obtained 20,000 nuts from Queensland for this purpose. The "Queensland nut" is closely allied to, if not identical with, the candle nut (Macadamia Ternifolila), and is one of the most nutritive nuts in the world. It has a very hard and thick shell, and in planting operations selection is employed by choosing the nuts for seeds with comparatively thin shells.—*F. Times*, Oct. 13.

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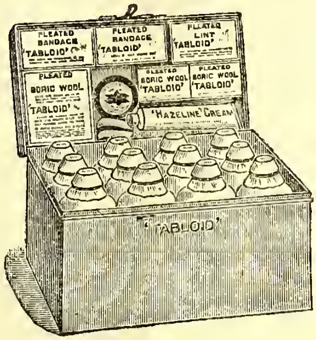

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THE FRUIT INDUSTRY OF CUBA.

Cuba has a wide range of fruit, some of which are very strange to the foreigner. The plum (ciruela) grows directly from the branches of the tree with no stems. The fruit is somewhat astringent, which however is not disagreeable when one is accustomed to it. The mango pertains to the peach family, the trees grow to a large size and bear a fruit which has a shape similar to a peach but is more oblong. The peel is smooth and thick and is easily removed. The fruit has a large seed covered with a fibrous growth which threads itself through the meat, is very luscious and very much prized, but many persons do not like it because of the slight taste of turpentine in it. The aguacate, or alligator pear, grows to perfection, and is used for salads. In size and shape it is not unlike a large pear. The sugar apple is very sweet, with mealy sugary interior. The sour sop (guanabana) is of the same family as the sugar apple. It is used largely in the preparation of refreshing drinks, in ices and ice-cream. The sapodilla (zapote) is a flat round fruit, about the size of a golf ball, and in colour resembles an Irish potato. There are several varieties of this fruit. The caimito is a combination of the plum and the fig. Some caimitos are green, and others have a purple exterior. They are very palatable, and are filled with a soft jelly-like substance with an agreeable juice. The mamoncillo is a small round, green or russet fruit about the size of a large marble, filled with a very acid juice. It has very little meat, as the large seed leaves little room for the juice and the yellowish meat which surrounds it. This fruit makes a delicious drink. The guava is used for making exceptionally fine jellies, marmalades and preserves. The peel is occasionally used in a home-made brew of beer. Guavas grow in great abundance throughout Cuba on bushes and small sized trees. The mamey Colorado grows on large trees, and is a fruit resembling a russet apple in colour and about the size and shape of an ostrich egg. The fig grows well in Cuba, the black green and Symrna varieties all thrive, but, according to a recent report of the Cuban Ministry of Agriculture, no effort has been made to cultivate them since the retirement of the Spanish Government. Before that time the cultivation of this fruit was prohibited, except one tree which was allowed to each family. This was said to have been done to protect the home (Spanish) industry. The same law also existed against the cultivation of grapes during the Spanish sovereignty. There are, however, old grape vines in Cuba which have never had any cultivation, but which are prolific bearers of excellent fruit and thus show what an opportunity awaits those who will engage in the intelligent cultivation of the grape in Cuba. In connection with this it may be said that there is probably no country in the world which consumes so much

wine *per capita* and produces less. Pineapples and oranges are grown in Cuba. As regards the latter, the fruit is very fine, and when the young groves now coming into bearing more fully develop, Cuba will make a strong bid for a high place in the fruit market of the world. Bananas grow to perfection, particularly in the eastern part of the island, where large banana plantations are under cultivation, more than 99 per cent of the production going to the United States. In addition to the banana which is eaten as a fruit, there is another variety known as plantain, which is used for cooking purposes. Green plantains when cut thin and fried are much appreciated in Cuba, and are said to be far more nutritious than potatoes. They are also used in soups and stews, and are baked and prepared in many ways. —*Journal of the Royal Society of Arts*, Sept. 29.

CINNAMON AND CASSIA.

With the extension of rubber and coconut cultivation in Ceylon, owners of cinnamon plantations in suitable localities have found it to advantage to root out cinnamon and plant either rubber or coconuts. It hardly pays the cinnamon planter to continue cultivation of the product at existing prices, and a good many of them have substituted the more remunerative products for the spice. This is especially noticeable, says the "Storekeeper," in the Southern province, where rubber is replacing cinnamon, and in the Negombo district, where coconut cultivation is being extended. As a result of all this there is a scarcity of cinnamon in the market just now.

To make good the deficiency in the European market, cassia bark, imported from China, is being used as a substitute for cinnamon. It is not improbable that it will swamp the cinnamon trade completely if the cultivation of cinnamon is not encouraged. A rough estimate places the acreage of cinnamon cultivation in the island of Ceylon at 45,000 acres. The total exports of this product for 1910 amounted to 6,286,060 lb.—*Magazine of Commerce and British Exporter*, for Oct.

SUGAR, TEA AND COFFEE.

Some Government statistics which have appeared recently throw light upon British tastes, and the extraordinary capacity of British stomachs in certain directions. Thus the amount of sugar we eat in one form or another is astounding. We import more than one-tenth of the world's production, which was estimated at 15¼ million tons in 1910. Of the total product, more than half (8,600,000 tons) was cane sugar, and the rest beet. Of beet sugar, Germany produced two million tons last year, and it is the semi-failure of the German crop that is mainly responsible for the sharp rise in prices. How serious this rise has been I may illustrate from the fact that it costs a laborer with sixteen shillings a week and a large family an additional sixpence a week! With sugar we naturally associate tea, and here again our consumption is enormous, amounting in 1910 to nearly 287 million lb. But why is coffee (the national drink of the United States) of so little account here? Our consumption of coffee last year was only just over 29 million lb., about one-tenth that of tea.—LUCELLUM.

RUBBER FUTURE DELIVERY DEALINGS.

GUARANTEED SPECULATIVE CONTRACTS.

We understand that before long the London Produce Clearing House will be prepared to accept terminal contracts for hard Para and Plantation rubber. All contracts put through the institution are guaranteed by it in the same manner as are the speculative dealings in sugar and coffee, all of which are passed through the London Produce Clearing House. [The London Produce Clearing House, Ltd., has offices at 21, Mincing Lane, and was registered in February, 1888, with the object of "placing on a secure basis by a system of deposits the dealing in produce for future delivery." The authorised capital is one million in £10 shares, and has paid large dividends from the commencement. It will be called to mind that we have persistently advocated reforms in the method of rubber dealing as carried on in Mincing Lane hitherto with the long-drawn out public auctions and resolutions and private dealing.]—*F. Times*, Oct. 19.

POSITION OF THE LONDON PRODUCE CLEARING HOUSE.

While particulars of the scheme which has been put forward for the extension of the business of the London Produce Clearing House to include dealings in rubber have not yet been completed, the matter is actively in train, and it is probable that full details of the proposals and terms upon which the business is to be conducted will be settled within a few days. It is probable that some variation from the rules which govern the contracts for future delivery of sugar and coffee will be made in case of rubber, but the net effect—namely, that the due fulfilment of the contracts will be guaranteed by the Clearing House—will be the same.

The London Produce Clearing House, Ltd., might more properly be termed an insurance or guarantee company rather than a Clearing House, and it fills a very important and useful position, especially as regards dealings for future delivery in sugar and coffee. It guarantees the due fulfilment of the contracts made between its members and, broadly, the procedure, without the technicalities, is as follows:—One member of the Clearing House sells to another member of the Clearing House, say, sugar for delivery in May. Before this contract is considered to be completed by the rules under which the sale and purchase are made, each party has to make a deposit with the Clearing House according to the amount involved, and thereupon the Clearing House guarantees the contract The deposit is used by the Clearing House for settling differences which may occur owing to the fluctuations day by day in the price of sugar, much in the same way that differences are paid on the Stock Exchange at each Settlement when stock is carried over, except that in the case of the Produce Clearing House "differences" have to be settled each day, and their payment is guaranteed by the Clearing House, whereas no

guarantee is given by the Stock Exchange, and differences are paid at the fortnightly Settlements. Should the margin or deposit held by the Clearing House become exhausted, owing to a continued rise or fall in the price of sugar, the Clearing House would at once demand a further deposit from either the buyer or the seller, as the case might be. By these methods of daily settlement of differences, supervised by the Clearing House, the position is regulated, and it has been stated at meetings of the Clearing House that during the twenty-three years it has been established the Company has never made a loss, the additional deposits having always been forthcoming when required Questions of interest and fees for arbitration on quality of sugar or coffee delivered are included in the rules of the Clearing House.

The London Produce Clearing House, Ltd., has had a very successful career, and its business has, we are informed, shown further very considerable development during the current year. Its coffee business to date has been double what it was for the corresponding period of last year, owing to the rise in price of that commodity. For the whole of 1910 the contracts registered by the Company in Santos coffee covered 2,622,250 bags. The Company's sugar turnover up to the end of September had reached the enormous total of 31,473,500 bags, or over 100,000 bags more than for the whole of 1910. Here, again, the fluctuations in prices has led to increased business in "futures." This year also the Company has extended its operations to pepper, which, however, is, of course, only a small item compared with the coffee and sugar business. The important international relations which it enjoys has had a great deal to do with the development of the Company's business in sugar, and it is quite possible that these will aid it in the proposed extension of its business to rubber. —*Financial Times*, Oct. 20

GUARANTEED CONTRACT BUSINESS TO START NEXT MONTH.

With regard to the proposed extension of the business of guaranteeing terminal contracts in produce carried on by the London Produce Clearing House so as to include rubber, the first intimation of which we were able to give in our issue of 19th instant, we understand that it has now been definitely decided to make a commencement with the new business early in November. A circular setting forth the terms upon which the business will be conducted will be issued next week by the London Produce Clearing House.

There appears to be a considerable demand here for facilities to enter into guaranteed terminal contracts in rubber, but the London market is not yet properly organised for this business, so that, we are given to understand, in the meantime, and in order to avoid any delay in making a commencement, the Antwerp rules are to be taken as the basis for operations. We may point out that a complete organisation exists in Antwerp for guaranteed terminal contracts in rubber.—*Financial Times*, Oct. 27.

AMENDED RULES GOVERNING CONTRACTS FOR PLANTATION RUBBER.

The following rules and regulations governing contracts for plantation rubber sold under the General Produce Brokers' Association of London Rubber Rules were agreed to at a meeting of the trade at the Commercial Sale Rooms, Mincing Lane, on Tuesday.

Prompt.—Prompt Saturday fortnight from date of sale or tender. Sales or tenders dated on Saturday to be prompt that day fortnight. Draft ½ per cent. Discount 2½ per cent. Interest at 5 per cent per annum on all pre-payments. The goods are at the risk of sellers (to the amount of the contract value only) until the prompt day, or delivery of the rubber from the warehouse before that day.

Weighing.—Weighing at the option of the seller at any time between the Wednesday week preceding prompt and the Thursday before prompt day, both days inclusive.

Clause I.—In contracts of five tons or over buyers shall have the option of rejecting any tender of less than one ton, and in contracts of under five tons any tender of less than halfton, except in each case in completion of a contract.

When sold for monthly deliveries or shipment each month or specified part of a month's delivery or shipment to be treated as a separate contract.

Clause II.—On contracts for rubber sold under the standard description of "first Latex Hevea Brasiliensis Plantation Rubber of fair average quality in sheet and/or biscuit and/or crepe form as at present prepared" for future delivery, the rubber, when tendered, must be ready for delivery in sound order and condition at one of the customary docks or wharves. The tender to be received by the first buyer before 3-30 o'clock (11·30 o'clock on Saturdays), not later than the fifth working day before the end of the period of delivery (excepting only in the case hereafter mentioned), and the first and each subsequent buyer must pass same on with due despatch, but in any case within 1½ hours of receipt (tenders received between 12-30 and 1-30 must be received by the next buyer before 3 p.m.) but in no case later than 5 o'clock on the last working day of the period of delivery (1 p.m. on Saturdays). For the purpose of this clause a day is to be taken as commencing at 10 a.m. and ending at 5 p.m. (Saturdays 1 p.m.) and for the purpose of this rule the buyer shall be represented by the selling broker.

For any tender received after 1 p.m. on Saturdays the prompt to be exact 14 days from the following Monday, and during further circulation of the tender prompt to be exact 14 days from the date of such subsequent tender is received, but weighing in all cases to take place as from original tender date.

All first tenders must have a time form attached which must be passed on with all subsequent tenders, the time of receipt being marked by each person receiving it. If any intermediate buyer divides a tender he must make out duplicates of time form and pass on a copy with each part of the divided tender. Any party failing to re-tender within the times specified as above becomes a first seller,

All rubber before being tendered must have been passed by the Arbitration Committee, and the award will remain in force for three months provided the cases have been left intact at the original public warehouse. Samples to be arbitrated upon must be freshly drawn dock or wharf samples, and delivered intact to the first selling broker, but in the case of any lot which has been included in the last public sale preceding the date of tender the dock or wharf samples shown at that time shall be sufficient if reasonably intact. These samples must be sent to the Arbitration Committee not later than 12 o'clock on the eighth working day before the end of the period of delivery, with liberty to the seller to make one replacement of any quantity rejected by the Committee within two days of receiving notice of rejection (provided that in the opinion of the Committee the samples submitted to them was a *bona fide* submission for tendering) and notwithstanding that by reason of such rejection and replacement the seller would, but for this provision, be out of time to make his tender.

Tenders to be good must contain the following information :—

Date of contract and price.

Date of original tender.

Marks and numbers of packages with approximate weights.

Ship's name and dock or wharf where rubber is lying.

Weight of samples.

Reference number of award and date when passed by the Arbitration Committee.

First selling broker's name at whose office the samplos are lying.

Description of rubber.

Date of prompt.

Rubber to be tenderable in the original cases bearing its original shipping marks as shipped from the place of production.

The stipulations in this rule shall be deemed to be of the essence of the contract.

Clause III.—An Arbitration Committee composed of six brokers and/or associates, members of the General Produce Brokers' Association of London, shall be appointed annually by the trade to deal with all disputes; three to form a quorum, with power to the parties in dispute to appeal to the Committee of the General Produce Brokers' Association of London, according to their Rules.

Clause IV.—When a parcel of rubber is sold under the standard description of "first Latex Hevea Brasiliensis Plantation Rubber of fair average quality, in sheet and/or biscuit and/or crepe form as at present prepared" for a special shipment or for shipment by a specified steamer, and found inferior, or if any portion tendered be found inferior, buyers shall have the option of rejection, and the quantity so rejected, whether the whole or any portion, shall not constitute a delivery on the contract, but should the time for delivery have expired. the seller shall be allowed three clear working days to replace the quantity rejected (provided that the delivery of such quantity was in the opinion of the arbitrators a *bona fide* tender), otherwise Clause IX. (f) of the Rules of the General Produce Brokers' Association of London to apply.

Clause V.—When a parcel of rubber is sold with a guarantee of quality other than as specified in Clauses II. and IV., for a specified shipment or delivery, or for shipment by a specified steamer, and found inferior, or if any portion tendered be found inferior, the buyer must accept the same with an allowance, provided such allowance in the opinion of tho arbitrators be not more than 2d. (two pence) per lb. or otherwise as may be specified in the contract, but should the parcel, or any portion tendered, be rejected, the seller to have the option (provided that it was in the opinion of the arbitrators a *bona fide* tender) of substituting guaranteed quality on the spot, to fulfil his contract within three (3) clear working days, or the expiration of time for delivery as the case may be, otherwise Clause IX. (f) of the Rules of the General Produce Brokers' Association of London to apply.

Clause VI.—Any claims under these clauses (and a copy of the objections must be sent to the parties interested) must be made by the last buyer to the first selling broker within (3) three clear working days of the last buyer receiving tender, and the first seller shall consider this as being in time, providing tenders have been passed on without undue delay.

Clause VII.—Delivery Weight.—Final delivery on any delivery or shipment contract to be within 50 lb. of the weight contracted for.

Clause VIII.—In the event of there being more than one contract subsisting between the same parties which shall be closed in pursuance of Clause XI. of the conditions of sale of tho General Produce Brokers' Association of London, an account shall be taken of what is due from the one party to the other in respect of such contracts, and the sum due from the one party shall be set off against any sum due from the other party, and the balance of the account and no more shall be claimed or paid on either side respectively.

Clause IX.—The selling or buying broker guarantees the solvency of his principals in all contracts for rubber unless otherwise specified in the contract.—*India Rubber Journal*, Oct. 14.

THE SOIL AND THE PLANT.

Dr. E J. Russell, of Rothamsted Experimental Stating, has a paper in "Science Progress" reviewing some recent American hypotheses which seem to upset several established points as to soil. Dr Russell, after a careful examination, arrives at the following conclusion which indicates the differences as well :—

The outstanding differences between Whitney's hypotheses and those more generally accepted may therefore be reduced to three :

(1) Whitney supposes all soils to be chemically alike in that all are made up of the same rock material ; consequently the soil solution is the same in all cases. Other chemists, on the other hand, consider that the soil is more complex, containing colloidal decomposition products and a solution which not only differs in composition in different soils but also shows local variations in composition in different parts of the same soil.

(2) He further supposes that variations in concentration of the soil solution have no effect on the rate of growth of plants and that in consequence all soils are equally rich in plant food; added fertilisers owe their value to other than nutritive effects.

(3) He considers that infertility must therefore be due to other causes than lack of nutritive compounds; dismissing considerations of nutrition altogether, he supposes instead that infertility arises from the presence of toxic organic compounds, some of which at any rate may be plant excretions. We, on the otherhand, attach great importance to the nutritive functions of soil constituents and of added fertilisers; while some of us agree that part of the infertility of "sour" soils may be due to toxic substances (and apparently the soils examined by Whitney and his colleagues were "sour" soils), we cannot accept the view that plants excrete toxic substances.

There is no doubt that the work of the Soil Bureau has suffered from leaving out of consideration all biological changes going on in the soil. The decomposition by micro-organisms of the residues of previous generations of plants gives rise beyond doubt to quantities of plant food, yet the function of this nutrient material is never considered; instead, attention is concentrated on possible toxic substances to the exclusion of useful substances. Thus the field of view is unduly restricted.

The investigations have, however, served a very useful purpose in stimulating inquiry and they have brought home the fact that the relationships between soils and plants are complex, it is no longer possible to take the old narrow view that the soil simply supplies food to the plant: the earlier papers compelled recognition of the fact that the size of the soil particles which regulate the water and air supply is more important than their chemical composition, and consequently that mechanical analysis is more useful than chemical analysis in characterising soils; the later papers direct attention to possible toxins of which we may have some in our own "sour" soils. We can find much to criticise in the details of the experiments and still more in the conclusions drawn from them; not infrequently the facts themselves are in dispute. Above all we should like to see a re-examination of the fundamental positions based on definite crucial experiments and consideration of alternative hypotheses. But, whether further work support their hypotheses or not, Whitney, Cameron, Schreiner and their colleagues have made agricultural chemists re-examine their ideas on the soil, and such a reconsideration must in the end advance the subject, however troublesome or superfluous it may at the time appear.

IS THE BANANA SEEDLESS.

I read the article under "Acclimatisation," by Frederick Boyle, in the *Field* of Aug. 19th, 1911, in which he says:—"All wild varieties of plantain or banana have a great stone with a kernel. . . . But in the cultivated form there is no stone; only a few black specks remain for a testimony. The seed has vanished." When tea planting in Assam I frequently came across the wild plantain in the jungle when shooting. These bore small bunches—five or six to a bunch —of small red fruit, but I never noticed either stone or seed in them. On the other hand, there was a large variety, about 8 in. long by quite 3 in. in diameter, much esteemed and cultivated by the natives, which were full of seeds about the size of a pea, but rough in shape, more like a mangei seed, and for this reason not used by the Europeans, though of good flavour, but rather slimy in texture.—ASSAM. [There are at least twenty species of Musa, and they are all supposed to be natives of the Old World tropics. One of these, viz., *M. sapientum*, is represented in all tropical countries by cultivated varieties, all of which, so far as is known, are seedless. These varieties bear the same relationship to the type as the cultivated varieties of apples bear to the wild crab (*Pyrus malus*). The wild form or type of *M. sapientum* is said to produce seeds, but we have never seen one. Should any of our readers have an edible fruited banana which produces seeds we would like to receive a sample of the fruit. The Chinese banana (*M. cavendishii*), known as the Canary banana, is not known to produce seeds.—ED.]—*Field*, Sept. 23.

I notice in last week's *Field* under the above heading that seeds are rarely met with in banana fruits. When I was staying in Ceylon, at Bandarawela, in 1906, I found three seeds, in different bananas; they were oval, black and not so large as a sweet pea seed. The banana were the small yellow kind, and much nicer to eat than the large ones. I planted the seeds which I returned home, but unfortunately they did not grow.—T. W. RUSSELL.—Ibid., Sept. 30.

TEA AND COPRA TRADE OF ODESSA.

Mr Consul-General C S Smith, reporting on Odessa for 1910, says:—The quantities of Colonial products imported were about the same as in 1909. Prices were in general steady, except for coffee, of which the price rose considerably on account of the failure of the Brazilian harvest. Coffee came mostly from Hamburg. The finer kinds are little drunk. The cheaper kinds are most asked for; they are also replaced by cheap substitutes. Tea comes by sea from Calcutta and Colombo houses. It mostly goes in bond to Moscow.

Of the copra imported it is probable that about 25,000 tons were sold in Odessa. The copra trade used formerly to be in the hands of a few large import firms with houses in Singapore and London which were represented at Odessa by agents of high standing. The business has now passed into the hands of produce brokers in London. The oil crushers in Odessa agreed amongst themselves at the beginning of 1910 only to sign contracts containing the following clause:—"Shipment by first steamer in (term of shipment) under through bill of lading direct or indirect for Odessa, but should the steamer be lost homewards before reaching Singapore, or arrive there later, in such event the copra to be shipped by first steamer available, provided the copra is shipped not later than 15 days after term of contract, in the latter case an allowance of 2s. 6d. per ton to be paid to buyers."—*Financier*, Oct. 5.

EUROPEAN FRUITS IN THE TROPICS.

The last number of the *Tropical Agriculturist* contained an account of a visit paid by the Secretary of the Ceylon Agricultural Society to a fruit farm in Bangalore, where over a hundred acres of different kinds of European fruits, consisting of apples, grapes, plums, peas, &c., are being grown on a commercial scale, with a view to supplying the Eastern market. From all that can be gathered, the prospects are promissing and the success of the undertaking is likely to exert an important influence on the conditions under which attempts are being made to grow English fruit in the tropics.

Hitherto efforts at growing European fruits in Ceylon would appear to have been carried on—if not exactly in a half-hearted way—under circumstances which were hardly calculated to provide an efficient test.

So far we have had amongst us, only one individual (whose skill as a horticulturist is unfortunately lost to the island) who had any pretensions to a practical knowledge of fruit-growing as carried on in temperate climes, and that was the late Curator of Hakgala Gardens, Mr. J. K. Nock, sr. The work which Mr. Nock has done in the way of introducing and acclimatising new varieties of fruits and vegetables will always stand to his credit. With his English and West Indian experience, the late Curator brought his valuable technical knowledge into requisition for the benefit of this Island which will always recall his genial personality with kind thoughts, and his ready willingness to help the amateur with gratitude.

Ceylon has, however, never been witness to such enterprise as characterises the venture referred to above. That venture would appear to have been begun under peculiarly happy auspices, and carried on under the supervision of particularly shrewd business men. Given a careful selection of site, an unfailing water supply, ample funds, and skilled management, the experiment in the cultivation of any crop with the smallest chances of turning out a success is hardly likely to fail except to some unexpected and unavoidable misfortune.

It has to be remembered, however, that there is a great difference between the climate of South India and that of Ceylon, for while the hillcountry of the former has a comparatively dry climate that of the latter is notoriously wet. Taking Bangalore, with an elevation of some 3,000 ft. and a rainfall of some 30 inches, we find that a good many English fruit have been grown with comparative success; while the same fruits do not thrive at the higher elevation of Nuwara Eliya owing to its humid atmosphere. But there are probably more likely places (in parts of Uva, for instance, and in Hewahetta) that have not been given the opportunity of proving their suitability. We have heard of figs fruiting in the Matale district and excellent grapes being produced in Hangurankette, facts which go to indicate that given enterprise, business acumen, technical skill and capital, it is not impossible that temperate fruits could be successfully raised in the Island with its variety of climatic conditions.

The most important desideratum in any venture of this kind is undoubtedly a thoroughly qualified fruit expert—one who not only knows the practical details of his art but the principles that underlie them, and could apply the latter to the varying conditions of a tropical or semi-tropical country, that could so to speak, make his plants adapt themselves to the locality in which they are being grown. One of the chief obstacles in growing temperate plants in the tropics is to induce what is known as the dormant conditions corresponding to the period of wintering. If, as we understand, it is possible to overcome this difficulty, then the prospect of raising English fruit must be looked upon as hopeful. As regards financial considerations we have the advantage of such fruit-growing countries as the Australian States and California, inasmuch as while labour is infinitely cheaper, there is always a ready market and good prices for English fruit in the tropics.

THE WILD POTATO OF CHILI.

Some excellent results have been obtained by Professor Heckel in the experimental cultivation of the *Solanum maglia*, or wild potato of Chili, at Saint Jerome, near Marseilles. In a communication to the Academie des Sciences, the professor states that each plant produced on the average two kilogs (nearly 4½ lbs.) of tubers, which are of a violet colour. The average weight of each tnber was 350 to 380 grammes (12 to 13½ ounces). The wild potato under cultivation is very hardy, and less liable to cryptogamous diseases than the common variety grown in Europe. Specimens of every known variety of the wild potato found growing in South America, both on the sea coast as well as at high altitudes in the Andes, have been obtained for further experiments.

[The Agricultural Society should get seed. —Ed. *C.O.*]

NYASALAND'S PRODUCTS: TEA AND RUBBER.

COTTON AND TOBACCO LEADING: "THE BEST UPLAND STAPLE IN THE WORLD."

The report on the Blue-book of Nyasaland Protectorate for 1910-11 says:—

A general review of the agricultural situation shows that the past year has been most successful, as evinced by the largely increased export of agricultural produce, the general prosperity of planters, and the keen demand for agricultural land within transportable distance from the railway. The forward movement reported last year has continued. Cotton and tobacco may now be considered as the principal cultivations of the Protectorate, and as likely to increase if transport facilities are extended.

Coffee is still being discarded in favour of cotton and tobacco, the total acreage of this crop for the year under review being only 5,629½. The season, although favourable for cotton and tobacco, was unfavourable for coffee, with the result that the total export for the past year amounted to no more than 334,161 lb., as against 748,410 lb. in the previous season.

The year under review was the best cotton season which the Protectorate has experienced, cotton ripening late into the season, and on many estates producing the heaviest crop that has been reaped since its introduction as a European cultivation. The European acreage increased from 8,975 in the previous year to 12,752 for the year under review, whilst the crop at present being harvested covers over 23,000 acres. The exported crop, in bales of 400 lb. for 1909-10 amounted to 2,147, and for the year under review to 4,342, showing an increase of over 100 per cent. in a single season. A gratifying feature is the increased interest which planters are now taking in seed selection. The results of the experiments carried out on the Government agricultural stations show the great advantage and profit of such work as is being undertaken there.

GOOD QUALITY COTTON.

The quality of the staple has been maintained, and the first-class cotton of the Protectorate shows such improvement that its valuation fluctuates more with the Egyptian crop than with the American crop as in the past. The large Egyptian crop last season made prices a little lower than in the previous season, but the top price of the season—viz., 1s per lb—shows that Nyasaland Upland still maintains its position as the highest-priced Upland cotton in the world. This excellent variety is becoming thoroughly acclimatised, and its success in West Africa and Rhodesia indicates that it will become in time the most extensively-grown variety in the new cotton fields of Africa. Its special quality is its wonderful adaptability to elevations of from 1,000 to 3,000 ft., its high degree of immunity from bacterial blight and its hardiness.

The Egyptian crop on the lower river was more successful than in the previous year, as planters now understand that it is useless to attempt to grow Egyptian cotton except on the best-drained parts of plantations at elevations under 1,000 ft.

The native cotton crop has risen from 220 tons to 692 tons. In several districts this industry has now become so thoroughly established as to admit of the withdrawal of the hut tax rebate which was allowed as an incentive to native cultivators when the enterprise was first introduced. The experiment of encouraging natives to apply themselves to this cultivation has proved a remarkable success in every way. It is worthy of note that some of the native cotton from Mlanje district has sold for as much as 1s. per lb.

TEA PLANTATIONS.

A large increase in the acreage of tea plantations has to be recorded, viz., from 518 to 1,037 acres. The export of tea was 42,042 lb. as against 34,601 lb. The area of tea actually in bearing, however, is still relatively small, the crop being one which requires several years to arrive at the productive stage. The success of this industry has attracted much attention and interest, with the result that improved machinery for the treatment of the crop has been imported, and considerable competition has arisen for land in the tea-growing protions of Mlanje district.

The tobacco season has been satisfactory, although not quite so good as last year. The acreage under this crop is 3,274, while the export of tobacco for the year under review amounts to 1,704,637 lb. as compared with 1,084,757 lb. in the previous year.

RUBBER.

The acreage under rubber is still increasing (present acreage, 9,072½), and, although no estates are in full bearing, rubber promises well in Mlanje, West Shire, and parts of the Shire highlands. It is now proved, however, that rubber cannot be profitably cultivated in all parts of the Protectorate.

Para rubber in the West Nyasa district still continues to show much promise, and the acreage under this crop has been increased to 726½ acres in the past year.

The exploitation of Landolphia parvifolia has been carefully conducted by the African Lakes Corporation, Limited. The value of this product is satisfactory—viz., 3s 9d to 4s 4d, with fine white Para quoted at 5s 2½d. Good prices have led to a large increase in the export of rubber, extracted principally from wild vines. The total quantity exported during the year under review amounts to 59,471 lb. —*Financier*, Oct. 28.

CHINESE TEA-SEED OIL.

Tea-seed oil is the name applied to an oil expressed from the seed of the Camellia Sasanqua. This is not the tea-tree (*Camellia Thea*), nor can its leaves be used. It grows principally in Honan, but is found wherever the wood-oil tree grows. The seeds are gathered in October and the extracted oil usually reaches the market in Hankow about the middle of winter. It is used by the Chinese as a cooking oil, and costs in the market from thirty-one shillings to thirty-three shillings per picul of 133⅓ pounds. Hankow's exports of this oil to foreign countries and Chinese ports in 1909 were valued at £6,500, and during 1910 at £17,300.

THIRD INTERNATIONAL RUBBER AND ALLIED TRADES EXPOSITION.

New York City, September 23rd to October 3rd, 1912.

The above illustrates the New Grand Central Palace, 46th to 47th Street and Lexington Avenue, New York City, where Mr. Staines Manders has arranged for the Third International Rubber and Allied Trades Exposition, from September, 23rd to October 3rd, 1912.

GROWTH IN GIRTH OF TREES.

The following table is from figures supplied by Mr Ridley, the Director of the Botanic Gardens, Singapore. It shows the growth in girth, at 3 feet from the base, that may be expected from a fairly and treated rubber tree. The first two years' growth is very variable. During the next three years the girth should increase 6 in. every year. From the fifth to the 15th year the increase should be 3·4 in. annually, and from then on to the 20th year 2·3 in. Close planting will reduce this increase materially after the 10th year, and probably before that. Too closely planted trees sooner or later cease to show any material increase. The figures are for trees grown in good soil without manuring and with wide planting for example, 20 by 20 feet. An individual tree Mr Ridley has measured shows at 14 years a girth of 79 in. (this in the forest among other trees); another tree 32 years old is now 124 in. in girth. A rubber tree should be ready for tapping in its fourth or fifth year, according to the conditions under which it is growing:—

1st year	— inches	11th year	60 inches
2nd do	9 do	12th do	66 do
3rd do	14 do	13th do	72 do
4th do	20 do	14th do	78 do
5th do	24 do	15th do	80 do
6th do	30 do	16th do	82 do
7th do	36 do	17th do	84 do
8th do	42 do	18th do	86 do
9th do	48 do	19th do	88 do
10th do	54 do	20th do	90 do

—*F. Times*, Nov. 1.

THE PRIZES OF PEACE.

While Italy as a nation is busily pursuing the fruits of war, Turin is distributing the laurels of of peace. The awards at the International Exhibition have just been announced, and they indicate that the very high standard attained by English exhibits has not gone unregarded. One firm alone, Messrs. Burroughs Wellcome & Co., the manufacturing chemists. has secured no less than thirteen awards, consisting of eight grand prizes, two diplomas of honour, and three gold medals. This probably constitutes a world's record in awards received by a single firm at an exhibition open to all nations.